Electrical World

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Associated Manufacturers of Electrical Supplies

THAT the manufacturers of electrical supplies are in real need of some organization to safeguard their interests was never more apparent than when last fall the movement to have the Underwriters permit the use of bare concentric wire began to assume definite proportions. As a direct result of that propaganda, together with the realization which came with it of their unpreparedness to combat movements deemed to be inimical to their interests, the manufacturers of electrical supplies will organize an association next Tuesday in New York. Their aim will be to provide the machinery for concerted action in matters which vitally affect them. We cannot commend too highly the spirit manifested throughout all the deliberations incident to the formation of the association. The desire of the leaders of the movement has been to work in harmony with other electrical manufacturers' associations, the commercial and technical societies, and particularly to live in conformity with national and state laws. Certainly when permeated with such motives there can be no question of the ultimate success of the organization and of its beneficial influence on the industry as a whole.

An Opening for Engineer Commissioners

THE imminent reorganization of the New York Public Service Commissions by Governor Whitman presents an opportunity to bring about greatly needed engineer representation on these bodies. It is an opening for engineering societies to carry into practice what they have been preaching about the value of engineer membership on such commissions. If Governor Whitman reconstitutes the commissions on political lines alone, the results will be disappointing to him and to the public. If he seeks men with real knowledge of public utilities, he needs some engineers. Commissions have depended largely upon subordinate engineers for information, study and understanding in technical matters, but those advantages will be more useful to the community when they are found in the membership as well as in the ranks of employees. The accredited authorities to present the facts to Mr. Whitman are the engineering organizations.

Personnel of the Trade Commission

IT is disappointing that the Federal Trade Commission is not dominated by business men. If the initial commissioners were long-trained in commercial life, stepping from active mercantile careers to public service, there would have been an instant sympathetic appreciation of business problems. Just why the membership is not wholly of such men, keenly alert to the immediate needs of varied industries, we do not know. Public precedent, which may have had an influence, is set against regulators who are familiar with the practices which they are to regulate; if represented at all, these men are always in the minority in our commissions. In spite of this handicap on new commissions at the start, however, they usually acquire power as they acquire momentum. That is why the Federal Trade Commission is of even greater importance potentially than actually. If all its members are imbued with a hard-headed understanding of their large opportunity to promote trade, that will do much to overcome the highly disturbed industrial conditions.

An Unfair Rate of Return

A RETURN of 4½ per cent or 5 per cent is held to be insufficient in the Rochester electric-railway fare case by the New York Public Service Commission, Second District. Commissions as well as courts find it easier to decide what is not a fair rate than to lay down what is a fair rate. Such decisions settle individual cases but they do not chart the future. The Rochester decision says: "A 6 per cent return upon capital employed in the public service has been deemed to be a fair return. . . . In many cases a considerably higher rate of return has been held to be required." These are indecisive statements, and evidently the commission thought it superfluous to cite cases. Regulation is national policy, but there is no agreement as to what rates are really fair. If the government imposes its will upon helpless investors, agreement is possible on capital already invested, but unfair rates would be uneconomic and fatal to future financing. Six per cent with risk compares ill with a 4 per cent savings-bank return without risk.

Metallic Roentgen-Ray Tubes

IT is well known that the limitations on the output of an ordinary glass mercury-vapor rectifier are found in the softening of the glass walls under the heating effects of heavy loads, and that the output can be greatly increased when metallic walls are substituted. In a similar manner, Prof. Dr. L. Zehnder has recently drawn attention in the *Elektrotechnische Zeitschrift* to the increased power and convenience of an X-ray tube composed of metal, with the cathode supported in a large porcelain insulator. The anticathode is in metallic connection with the metal walls. This construction not

only lends itself to mechanical strength but also tends to make for security. The metallic tube, if grounded, may be safely handled; while the danger of injury to the person of the operator from long-continued subjection to stray X-radiation is practically altogether prevented. In fact, the tube ceases to be a delicate and brittle glass vessel. It becomes virtually a piece of mechanism with the qualities of metallic construction. Considering how recently X-rays have been discovered, their great potency and wonderful properties, it seems probable that various new applications will be found for them in the future. For such applications sources of powerful and sustained X-radiation may have to be employed, without the possibility of serious danger to the attendants. For those purposes a thoroughly mechanical form of X-ray generator is of great importance.

The Portland (Maine) Central-Station Service

As is true in many other cities, the electrical supply system for Portland, Maine, consists of several independent plants consolidated into a coherent whole. It includes three hydroelectric plants and a steam plant serving Portland directly, and through lease or stock ownership two important street-railway systems and the York County Power Company's system, which furnishes energy outside of Portland proper. In fact, nearly a score of cities and towns now covered receive energy from the network which has grown up around Portland. The total equipment rating of the allied stations is now somewhat over 33,000 hp, serving a population of approximately 200,000.

The three hydraulic plants of the company are the mainstay of its energy supply, the other stations being available whenever necessary as auxiliaries. Of the three plants, two are on the main stream of the Saco River and the third is on the Presumpscott, the outlet of Lake Sebago, with large storage capacity behind it. The main plant is that at Bonny Eagle, which contains six 1500-kw directly coupled units operating under a 39-ft. head. Two miles to the eastward is the West Buxton plant, utilizing a fall of 25 ft. and containing four 750-kw directly connected units, which, like the others, generate at 2300 volts and are provided with transformers which increase the emf to 38,000 volts. The third plant, which originally transmitted energy at 10,000 volts directly into Portland, contains four 500-kw units generating at 10,000 volts, step-up transformers being used for tying the plant to the rest of the system.

The main substation at Sewall Street is designed for four banks of transformers each of 3000-kw rating, the energy being received from the three hydraulic stations. From this substation the energy is distributed over the city at 2300 volts, to two railway feeders at 600 volts and to four arc circuits for the nearer part of the service. The transmission line is carried in the main on wooden poles with pin-type insulators, the circuits being connected in star with grounded neutrals. Use is made of a small amount of steel-tower work on one of the branch lines for a special river crossing. In all there are more than 90 miles of 38,000-volt line. Some very ingenious provisions, fully explained in our descriptive article, have been made for securing continuity of service in spite of local accidents. Owing to the reliability of the hydraulic privileges, very little use is made of steam. On the average, only about 2.5 per cent of the energy is derived from steam, which is a remarkably good record for so extensive and well loaded a system.

Maintenance of Line Insulation

It seems to be the well-nigh universal experience on high-tension transmission lines that the weakest point in the system is the insulation. Even thunderstorms, which used to be dreaded more than anything else in the way of casualties of service, have been eliminated from the problem of line maintenance by the skilful use of grounded wires and aluminum arresters; but the insulator is always with us. While the suspension type has relieved many of the difficulties on lines of exceedingly high voltage, yet with both these and the pin-type insulators there is sufficient trouble to justify the statement with which this comment started. The reason for such a condition is threefold: First, the insulator has, on the whole, the lowest factor of safety in comparison with the possible stresses of any part of the system; second, no method has been devised for testing insulators for their ultimate endurance when on the line; third, the insulators which withstand well the ordinary tests may be weak in endurance. These remarks are applicable to suspension insulators as well as to pin-type insulators, but they apply with a special force to the latter, because it is not so easy to give them a high factor of safety.

Insulators fail electrically through actual puncture or by flash-over and cracking. The first cause of failure can generally be pretty well eliminated by tests applied before the insulator is in service, and as a rule comparatively few weak insulators are found. Flash-over tests are less satisfactory as an indication of what the insulator is likely to do in the long run. In the first place, it is very difficult to imitate the insidious coating of the surface by the long-continued action of dust and moisture. Almost any first-class porcelain will withstand admirably a puncture test or a flash-over test dry, the limitation being the size and design of the petticoats. The efficacy of a flash-over test when the insulator is wet depends on the nature of the wetting. The ordinary spray test approximates in character a heavy but rather quiet shower of rain, and the insulator at the start is fairly clean and is washed even cleaner by the shower. Service conditions would be more nearly approximated by a very fine spray directed obliquely upon an insulator which had previously been coated with fine dust. It therefore happens that when the factor of safety of the insulator has been determined on the basis of a shower test the chances of breaking down later become quite appreciable, especially when, as often happens, the factor of safety between the normal crest of the voltage wave and the flash-over point is barely 2.

A good many lines are in operation at from 40,000 volts to 50,000 volts with pin-type insulators which will hardly withstand 75,000 volts on a spray test of the kind here assumed.

The moral is that in attempting to secure continuity of service one should not only obtain insulators of first-class porcelain thoroughly tested before acceptance but should see to it that the factor of safety is materially higher than the figure mentioned. A factor of 2.5 or preferably 3.0 is none too large for lines of fairly high voltage; moreover, there seems little doubt that pin-type insulators are in use on many lines which would be better protected with suspension insulators.

As a rule the failure of insulators is of a character which cannot be determined from initial tests. Mechanical strains existing in the insulator in the form of uncompensated stresses, or applied accidentally during service, are the cause of many failures. Glass or porcelain, particularly in fairly large masses, is very difficult so to anneal that it will be free of internal strains, sometimes of considerable severity. Glass insulators can be tested for strain in polarized light, but they are generally used on lines of such moderate voltage that the masses involved are small enough to permit thorough annealing. Porcelain cannot be tested in any direct way, and for the most part one must trust to luck. Then, too, the large porcelain insulators, made up in several parts and fastened together with cement, involve still further risks from the strains set up as the cement gradually hardens, and from the effects of unequal expansion and contraction under heat and cold, or from the strains caused by varying tension in the wires or the racking of the insulators because of a windstorm.

In many plants the abnormal electrical strains have been dealt with successfully by the use of arcing rods, but these mechanical failures will usually put an insulator in a condition where such protection is of little avail. Expansion and contraction, too, get in their work in other ways than by ordinary cracking. They may produce hair-like cracks through the outer surface of the porcelain, eventually permitting moisture to enter the more porous interior. It is more than likely that most of the failures in insulators after considerable service might be traced to such a cause. A damaged insulator may remain in service for a long time with simply a small leakage, and then fail disastrously when some unusual strain comes upon it. The practice of locating leaky insulators by suitable line inspection is one that should be encouraged. A very neat telephonic scheme for this purpose was recently described in an A. I. E. E. paper, a scheme which might easily be elaborated to meet the requirements of almost any kind of inspection. It is more than likely that a suitable wireless receiver and testing antenna could be applied to this work with advantage. At all events, the moral of the situation seems to be that porcelain is somewhat untrustworthy in large masses, even with very careful construction; that advantage should be taken of the suspension insulators with their smaller porcelain units in working at voltages anywhere near the limit of the pin-type insulator, and, finally, that the line should be watched systematically to detect if possible incipient faults that may result in failure of service.

Conditions Governing Commutation

Ever since commutators have been used on dynamo-electric machines they have been characterized by a tendency to develop sparking at their contact brushes. Some have even averred that they regarded a commutator as the abode of a malign agency for destructive sparking, so that a constant strife had to be maintained by the operators and attendants to subdue this vicious influence and keep it in check. The introduction of interpoles in modern direct-current machines has distinctly aided in the subjugation of this nefarious agency of Lucifer, but even interpole machines, if not properly designed or cared for, will escape from control. In the best of machines the spark imp lurks unremittingly.

In his interesting article on page 601 Mr. J. F. H. Douglas discusses the relative merits of two formulas which have been proposed for the use of designers in establishing a criterion as to the danger of setting up serious sparking. One of these is known as Arnold's and the other as Hobart's formula. Each may be expressed in the form that the average reactance voltage—that is, the average voltage set up by emptying the flux linked with each armature coil during the time of commutation reversal—should be less than a certain factor times the IR drop in the brush and brush contact. This IR drop is usually taken as from 1.0 volt to 1.5 volts. Whereas, however, one formula makes the factor unity, the other makes it 2; so that the certain factor is a somewhat uncertain factor, to the extent that one allows twice the limiting reactance voltage of the other.

The analysis given in the article goes to show that the unit factor corresponds to the assumption that at the end of each segment contact, when the segment is just parting company with the brush, the current density in the edge of the brush at the instant of rupture does not become indefinitely great. It may be conceded that if the current density does not run up enormously in the last little element of brush contact there should be no serious sparking. The question is whether quiet commutation might not continue somewhat beyond this limit, or after the final current density had increased enormously, with a doubled reactance voltage. It is suggested in the article that the criterion should be not the parting current density in the brush but rather the parting surface temperature. With this idea in mind, it is claimed that the double IR drop corresponds to the condition that the tip of the brush at parting with each segment cannot become indefinitely hot.

Of course, if the brush tip did become indefinitely hot, even for an indefinitely short interval in each commutation cycle, it would be difficult to say what would happen to the brush, so that the formula can hardly claim to present a demonstration. The idea is, however, ingenious and should be capable of being pursued quantitatively by suitable experiments.

LETTERS TO THE EDITOR

National Electrical Week

To the Editor of the ELECTRICAL WORLD:

SIR:—The idea of celebrating a special electrical development week is excellent. It occurs to us that the general public is already more or less familiar with "Edison Day." Edison represents to our industry and to users of electricity what Washington does to the country at large, and we feel that we should either make the special week contain Edison Day or else select the week that will contain Edison's birthday. Inasmuch as we have the public with us on these days, we should find a more ready response to any plans and greater willingness to assist. Co-operative schemes could be worked out to make the concentrated campaign very effective. Lectures in public schools, possibly large moving-picture shows, celebrations, electrical parades, expositions, etc. A thousand and one ideas and suggestions will occur to the geniuses and originators in our business if all pull together.

W. S. HAYS,
Cambridge, Ohio. *Superintendent Ohio Service Company.*

National Electrical Week

To the Editor of the ELECTRICAL WORLD:

SIR:—Your issue of Jan. 16, 1915, contains an article entitled "A National Electrical Week," which I have read with a great amount of interest. It seems to me that the suggestion made to set apart a week in the month of October for a vigorous sales and educational campaign is one which should be acted upon without hesitation, and that it should receive the earnest co-operation of all who are directly or indirectly connected with the electrical industry. The national committee having this matter in charge will no doubt put itself in a position to receive suggestions from any source which would contribute to make the week memorable in the history of the business, and it is probable that an opportunity will be given to put into effect every practical suggestion which will tend to help the cause along. The article referred to contains a list of ways and means which cover the ground very thoroughly from a general standpoint. Of course, the details would have to be worked out in each case. The concerted movement of all branches of the electrical industry is bound to obtain the results sought, namely, the education of the public and a corresponding increase in the sales of apparatus and appliances, and ultimately in the sale of electrical energy. However, the methods which would attract the attention of the public in one locality would not necessarily produce the same results in another. It is comparatively easy to attract public attention to any subject in a small city, but it is much more difficult to obtain the same amount of attention in the larger cities, and the methods which would prevail in the one community might require to be discarded in another. Consequently, the electrical fraternity in each locality should form a local committee to select from the many suggestions which would be turned in to the national committee such ideas as might be considered desirable and effective for use locally in connection with the week's campaign. The slogan among the electrical fraternity in connection with its preparations for the electrical week should be, "Advertise, exhibit and demonstrate," with the avowed intention to educate the public to "do it electrically." I add a few suggestions, which I have not seen referred to in this connection.

In order to draw greater attention to the illumination of stores and places of business during "Electrical Week" I believe that central stations could well afford to loan and install externally on consumers' premises many of the new high-efficiency lamps from 500 cp and upward. These lamps would increase the electrical effect upon the streets at night, and would to a greater extent illuminate the store fronts, with the ultimate result that many merchants would retain the lamps once they had been installed, after learning by demonstration the relatively small cost of operation. During "Electrical Week" all central-station offices and buildings should be decorated and illuminated both internally and externally so that the public would know at once that some event of importance was taking place. Merchants using electrical devices and appliances in connection with the operation of their business should be persuaded to invite the public to their premises to inspect these electrical installations. Such advertising would be advantageous to the merchants and would also help materially in the general results. During the week each town should have a general electrical exhibition which should be free to the public, or if a charge is made at all, it should be for a trifling amount. If held in nothing better than a vacant store, the exhibition will be of great value, particularly if there are demonstrators to explain the uses and advantages of the articles exhibited. It would be of immense advantage to all concerned if each of the many manufacturers of electrical devices and appliances which may be used in daily life would select one of the articles manufactured, and for the week in question allow it to be sold at a reduced price, this price to be effective only on sales made during "Electrical Week." Such a plan would induce the public to purchase more freely and consequently become more interested in the uses and adaptations of electricity.

In addition to electrical parades, which probably would be held at night-time, either electric trucks or gasoline trucks equipped with storage batteries displaying electrical apparatus could be sent through the streets of the city in the daytime. These trucks could have on them efficient demonstrators, and stops might be made at various corners where audiences could be obtained, when explanations should be given regarding the particular electrical devices on exhibition. The moving-picture houses could be used to great advantage during "Electrical Week," not only by means of having them flash electrical slogans and advertisements on their curtains between the regular pictures, but also by arranging for exhibits of special films which would tell attractive electrical stories to their audiences. There is little doubt that during "Electrical Week" the various ladies' clubs in different communities could be induced to take a special interest in electrical affairs and open their doors and give access to their platforms to those who would lecture in an interesting manner upon electricity and its uses, and no doubt arrangements could be made for demonstrations at such meetings. A great field for development, where electrical matters could be placed before eyes and minds that are always receptive, is in the public schools, and those in charge of these schools would no doubt consider it a proper variation in their educational work if during "Electrical Week" a day or part of a day were given up for the special study of electrical matters and inspection of electrical exhibits. Here, again, competent teachers or lecturers, whether they emanate from the central stations or from the manufacturers or contractors, should be on hand to help those in charge of the schools

to give the children the desired information in an approved manner, in order to turn their thoughts toward electricity and what it can do in making man's work lighter and his home brighter.

The national committee and the local committees which may undertake the directing of the "Electrical Week" scheme will surely realize that their task is a big one, but there is hardly a shadow of doubt as to the enthusiastic co-operation which they will receive from all branches of the electrical industry in every state in the Union.

S. M. KENNEDY,
General Agent Southern California Edison Company.

Los Angeles, Cal.

The Cost of Valuation

To the Editor of the ELECTRICAL WORLD:

SIR:—It is becoming increasingly evident that Judge Prouty's estimate of a total cost of $50,000,000 for federal valuation of common carriers has fallen like a wet blanket upon Congressional enthusiasm for the valuation work. From private remarks of some Congressmen it may be inferred that a not inconsiderable number of members of Congress might feel relieved if the whole valuation project could be quietly dropped. The situation well illustrates a certain tendency in public undertakings, the spirit of which is perhaps well illustrated in the old song, "Oh, Uncle Sam is rich enough to give us each a farm."

The government may take up a piece of work along conservative lines. All discussion of what it is proposed to do may be directed toward an unexceptionable program. Yet, after the work has been authorized, the thought of this or that desirable thing creeps into the minds of those in charge of the undertaking, and as compared with the vast wealth of our Uncle Samuel the cost of such things seems so trivial that it is easy to extend the original plan out of all semblance to its early shape.

In the case of the railroad valuations specifically it may be remembered that President Roosevelt wrote a letter to the Interstate Commerce Commission making certain inquiries about a federal valuation, its probable cost, etc. In reply President Roosevelt received a letter written by Prof. Henry C. Adams, chief statistician of the commission, who with Prof. M. E. Cooley, of the University of Michigan, had made the valuation of Michigan railroads some years earlier. Professor Adams stated that on the basis of the cost in Michigan the government would have to spend at least $1,750,000 in addition to what the railways would be called upon to spend. It is now a fair question to ask what added results we are likely to see from the $15,000,000 that it is proposed to have the government spend (it is estimated that the cost to the roads will be $35,000,000) over what might have been had upon the modest basis of the early work in Michigan.

It is understood that the extra cost is largely that of detailed and painstaking inventories, upon which will be based the "cost to reproduce" the properties, upon whatever hypotheses may be used. This matter of inventories may go to almost any length and cost almost any sum. A country railroad station, for instance, may be appraised from records, from over-all dimensions and the known cost of similar structures, or by measuring each stick of timber. Engineers may count the tacks that hold down the sheet of zinc under the cast-iron stove (similar things have been done in appraisals), or the total value may be arrived at without much detail of inventory and perhaps with about the same factor of error. When it is considered how much the final grand total will be affected by personal predilections of the directing minds it may be thought unnecessary to lay excessive stress upon purely engineering refinement.

Judge Prouty speaks of a possible error of 5 per cent amounting to $1,000,000,000. Quite true. But what is "error" in this connection? Let anyone look over the figures of valuations, either of railroads or of electric properties, that have been made recently. Let the final values of corporation and commission be compared. The differences will usually be nearer to 25 per cent than 5 per cent. Each is confident that the other is wrong. "Error" in these matters is error of judgment, and not error in measurement. Appraisal is not a scientific process, leading inevitably to a single conclusion. True a change of 5 per cent in the railroad valuation figure may be a change of $1,000,000,000, but such a change, or a greater one, might come through the Senate refusing to confirm one commissioner and getting another in his stead.

Finally, it should be noted that recent court decisions do not at all accept the theory that "cost" is synonymous with "value." The Court of Errors and Appeals in New Jersey has overturned the decision of the Board of Public Utility Commissioners in the Passaic gas case and specifically states that a substantial sum must be included in the total value to cover the item of franchise.

In the valuation of Michigan railroads the physical property was valued, and an allowance of what was deemed a reasonable rate of return was figured as the sum earned upon the physical property. As the actual earnings of the roads were greater than the return so computed as reasonable for the physical property, the excess was taken as the earnings on intangibles, and, assuming a rate of return for intangibles and figuring backward, the capital value of the intangibles was determined. A similar method for appraising intangibles was used some years later in New Jersey.

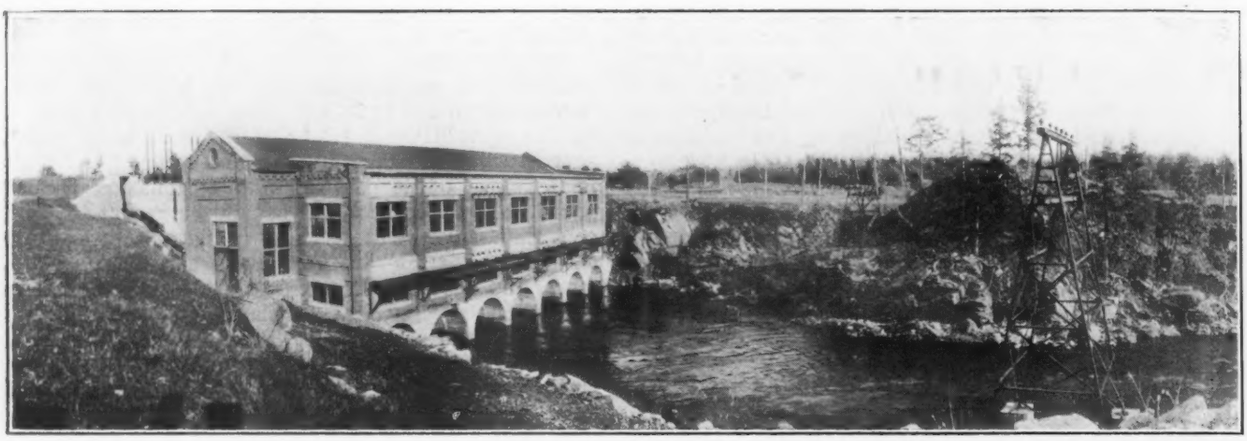
Obviously, if the same rate of return were to be assigned to physical and non-physical capital, the grand total of value might be had in a similar manner by figuring back from earnings, making the large expense for inventory seem absurd. By adopting a different interest rate for the two classes of property, and by introducing a few depreciation figures, this pitfall is avoided easily and the final result takes a very scientific appearance.

To those owners and managers of electric properties who have been through valuation and rate-making campaigns lately, some feeling of surprise is natural as they study a method of appraisal based upon the capitalization of earnings. It is not unusual in electric appraisals to allow a "going value," based upon development cost, but the capitalization of earnings to fix a value for their properties is, to say the least, unusual. It may therefore be pointed out, for whatever it may be worth, that the purpose of both the Michigan and the New Jersey appraisals was to fix an assessment on which the railroads should pay taxes.

If the Interstate Commerce Commission is to compute intangibles by the method used by Professor Adams in Michigan, it is obvious that the grand total value will be an extremely fluctuating quantity. One need merely mention that a few years ago certain railroads were selling 3 1/2 per cent bonds, while last summer the city of New York was issuing 6 per cent gold notes, in order to make clear how intangible values, if based upon capitalization of earnings, may shift. Judge Prouty's 5 per cent would be a small part of the probable fluctuation.

Is it reasonable to put so much expense into one-half of the valuation undertaking, when the other half of the same undertaking depends so largely, not upon exact computation, but upon individual opinion?

New York, N. Y. JAMES MACDONALD.



Central-Station Development at Portland, Me.—II

**Features of the Transmission System and of the Principal Substation—
Outline of Operating Methods and Commercial Practices**

THE first section of this article, which was published in last week's issue, gave an idea of the extent of the Cumberland County (Maine) Light & Power Company's generating system and contained descriptions of hydroelectric stations at Bonny Eagle, West Buxton and North Gorham. In this issue are descriptions of the principal substation and the entire transmission system, with outlines of the operating methods and commercial practices.

Principal Portland Substation

The Sewall Street substation was designed by Sawyer & Moulton, Portland, Maine, and is one of the most modern distributing installations in the East. The building is on a plateau about 2 miles west of the business center of Portland, and at present receives energy from three three-phase, 38,000-volt incoming lines. In the near future the two lines from North Gorham, which are now joined outside the city, will be separated, giving four independent lines into the substation. A 38,000-volt line runs from Sewall Street to Dunstan and Biddeford, with a branch to Westbrook. The substation at Sewall Street is designed to accommodate four banks of three 1000-kva oil-cooled transformers each, and there are two main sets of 2300-volt buses for local service and the tie-line work within the city, each set being divided into two sections. All incoming lines are equipped with the vane type of General Electric reverse-power relays, overload relays being provided on all power-station lines.

The substation building is a brick and steel structure about 103 ft. by 58 ft., with concrete foundations and floors reinforced by steel I-beams. It is two stories in height and at each end is provided with a feeder terminal house and structural steel dead-end frame for outgoing 2300-volt lines.

On the ground floor are installed the transformer banks, lightning arresters, two 500-kva synchronous motor-generator sets delivering energy for street-railway service in the western portion of the city, and two sets of three-phase, 2300-volt buses, with corresponding solenoid-operated oil switches. The second floor is divided into two sections with an open bay between. On one side are all the 38,000-volt oil switches and high-tension buses in the substation, and on the other are the main switchboard, a street-railway switchboard and groups of 2300-volt feeder switches. Sixty cells of "chloride E5" battery are installed in a room off the

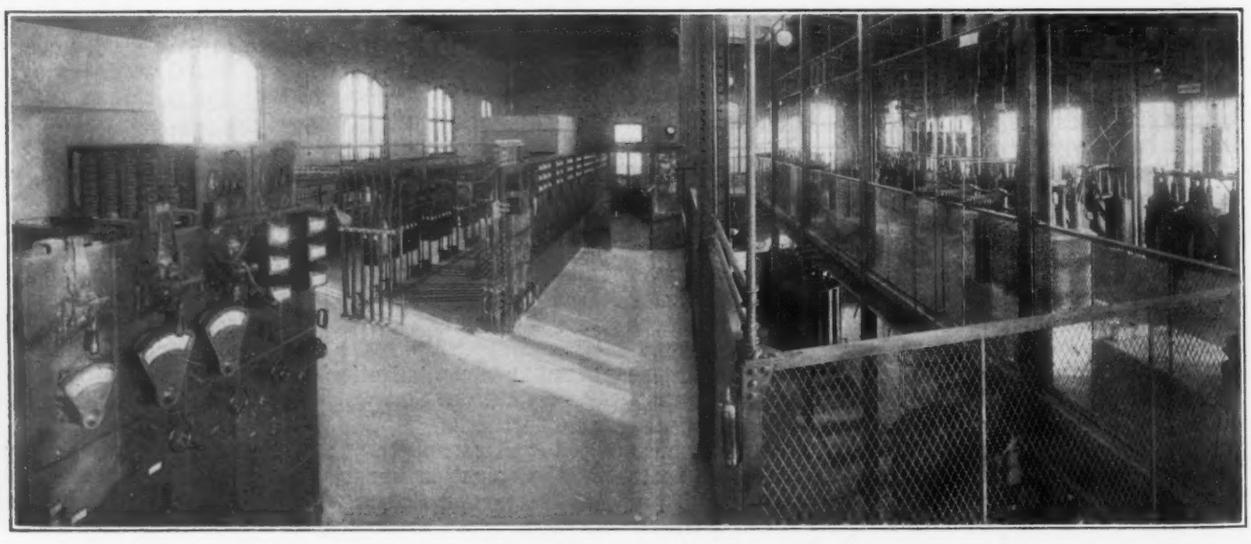


FIG. 11—INTERIOR OF PORTLAND SUBSTATION

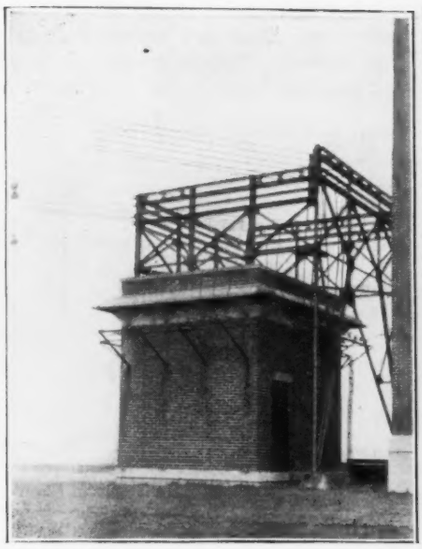


FIG. 12—TERMINAL HOUSE FOR 2300-VOLT FEEDERS

FIG. 13—TERMINAL CABINET FOR PORTABLE TELEPHONE SET

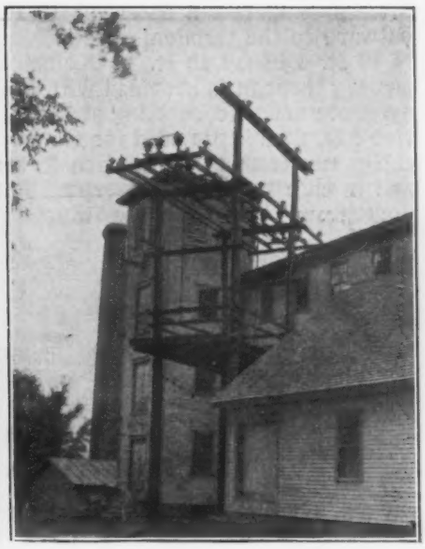


FIG. 14—BURKE HORN-GAP SWITCHES OUTSIDE WEST BUXTON PLANT

gallery for operating relays and solenoids, and a 25-kw, 125-volt motor-generator set on the gallery floor is installed for battery charging.

The incoming lines are dead-ended on double pin-type insulators set on wall brackets outside the building. Taps from the lines are carried downward to horn-gaps mounted 10 ft. away from the building wall, with connections from the gaps to the lightning arresters inside the building, which are of the aluminum-cell type mounted on concrete bases. The phase wires are carried into the building in each case through Thomas 44,000-volt bushings, and are protected by hoods. After passing through choke coils, disconnecting and oil switches, the lines terminate on the high-tension buses, which are of copper tubing, supported horizontally 24 in. apart and below the roof beams. At present only three banks of transformers are installed. The leads from the buses to the transformers are carried downward through oil switches, and the 2300-volt connections from the secondaries to the low-tension buses are so arranged that the secondaries of any bank can be connected to either of the two sets of three-phase, 2300-volt buses. Both sets are connected by tie cables passing through bus junction switches mounted on the under side of the gallery.

From Sewall Street are run two 600-volt railway feeders, four 6.6-amp arc circuits for the Deering district, ten three-phase, 2300-volt lighting and motor-service feeders for the Deering section, one three-phase, 2300-volt feeder each to the Knightville and Forest Avenue plants in Portland and four 2300-volt, three-phase tie lines to the Plum Street station. The tie lines are taken off the two buses on the first floor, through selector oil switches, and the motor-generators are fed from the same source, although controlled from the railway switchboard on the gallery. All commercial feeders are tapped off the buses on the gallery at the rear of the switchboard, the connections providing for the supply of energy to any feeder from either set of buses. The alternating-current service is handled by a switchboard of thirty-one panels, equipped with both remote control and manual switches, the board being partly inclosed by a glass housing which is electrically warmed in cold weather and which enables the operators to keep comfortable without heating the entire substation to a relatively high temperature. The railway board is a six-panel installation, with the usual apparatus. A 10-ton hand-operated crane spans the open bay between the two sections of the gallery.

The feeders are carried downward through the north wall of the substation from the buses in recesses inclosing 3-in. hard-fiber tubes set in cement grout, and

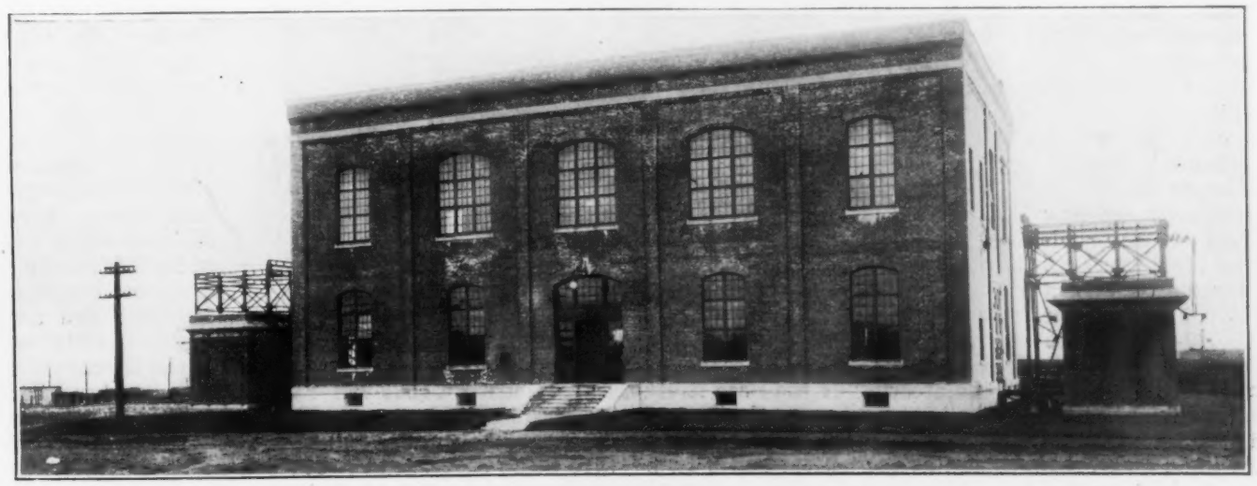


FIG. 15—SEWALL STREET SUBSTATION, PORTLAND, MAINE

after passing into a basement 10 ft. high are carried outward to the terminal houses. Each terminal house is 13 ft. 4 in. by 10 ft. 10 in. inside, and each circuit passing through is provided with choke coils, lightning arresters and disconnecting switches. A basement section 8 ft. deep is provided for gaining easy access to the cables run from the substation to the terminal houses, and in case the present overhead lines are changed to underground service in the future the terminal houses

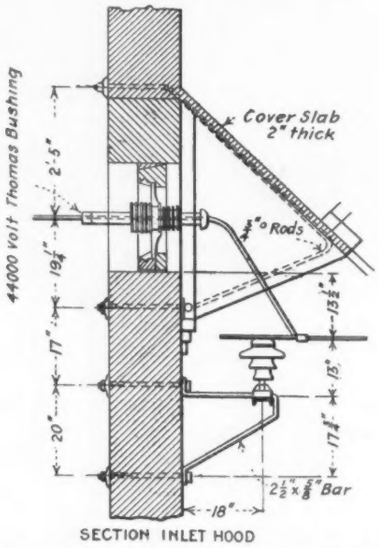


FIG. 16—PROTECTING HOOD FOR WALL BUSHING

are arranged to accommodate the cables. Short taps from the terminal-house switches lead outdoors through hooded bushings to the dead-ended lines attached to insulators on the steel framework.

Transmission System

The greater part of the transmission system is composed of No. 2 semi-hard-drawn copper carried in 36-in. equilateral triangular spacing on Thomas triple-petticoated pin-type insulators. These are mounted on cross-arms 8 ft. 10 in. and 5 ft. 10 in. long, carried on 35-ft. to 65-ft. chestnut poles with an average spacing of 100 ft. The circuits are Y-connected, with grounded neutral. Thomas 50,000-volt insulators are now used on all standard construction. A recent extension of the Dunstan 38,000-volt line to Biddeford is carried on steel towers at the crossing of the Saco River at Biddeford. Five towers have been erected. Two of these are anchor towers 68 ft. high and three are 206 ft. high, 40 ft. 8 in. square at the bottom and 8 ft. 8 in. by 8 ft. at the top. These towers are carried on concrete piers 10 ft. square at the bottom and 6 ft. square at the top, 6.5 ft. high, there being two 1.75-in. steel anchor bolts per leg. Each leg consists at the bottom of two 7-in., 9.75-lb. channels, the largest diagonal braces being of 2-in. by 2-in. by ¼-in. stock,

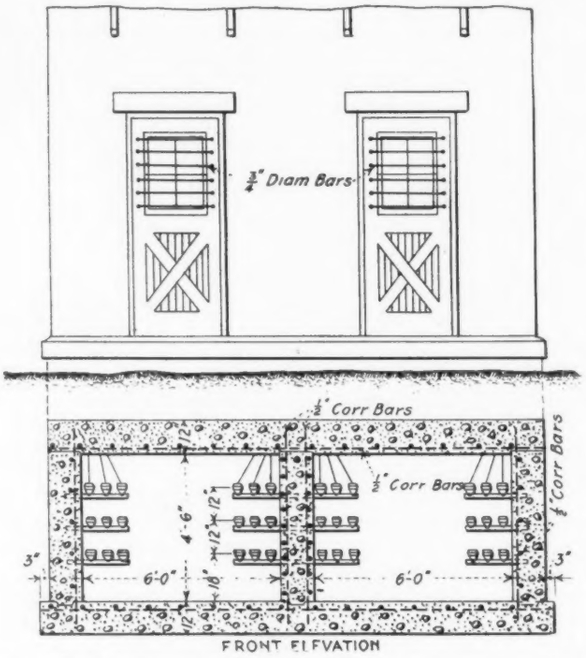


FIG. 17—TUNNEL CONNECTING WITH TERMINAL HOUSE

smaller sizes being used farther away from the ground.

Each tower carries six nineteen-strand, 7/16-in. copper-clad steel wires, each of which has a breaking strength of 11,120 lb., and the towers are designed to withstand the pull of six wires loaded with a coating of 0.5-in. of ice and 3400 lb. of wind load on each of the long spans. These are 1080 ft. and 1055 ft. long, and the clearance above tidewater is 160 ft. minimum. At the towers the lowest wire is 190 ft. above the ground. An intermediate tower on Cow Island forms the dividing point between the two spans. The wires are held in place by Thomas No. 1124 suspension strain insulators hung five in series, the attachments being made by suspension strain clamps. The towers were designed and erected by the Megquier & Jones Company, Portland, and are among the highest in the East.

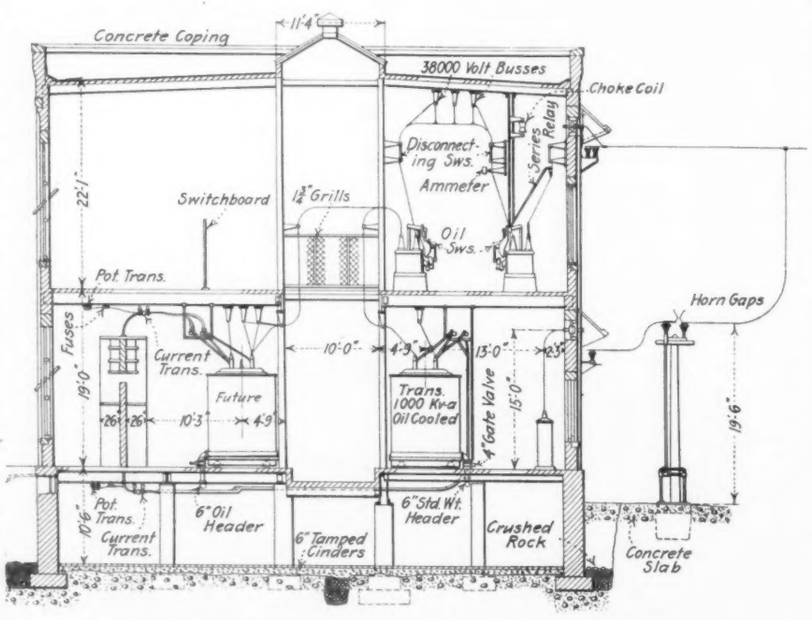


FIG. 18—CROSS-SECTION OF PRINCIPAL PORTLAND SUBSTATION

A standard 38,000-volt railroad crossing has been designed by the company. The crossing proper consists of a span of about 183 ft. length, nineteen-strand copper wire being suspended at each end on Thomas pin-type insulators carried on a ⅜-in. by 3-in. angle iron, the insulators being 6 ft. apart horizontally. The insula-

tors are of the suspension type on the inside of the span, where the copper line wire and the span conductor are connected, and two extra poles are provided at these points. All four poles are strongly guyed and are nearest station to that side of the box, leaving the telephone line open-circuited on the side where the switch is opened, while if both switches are closed, as in normal operation, the line is maintained solid from station to

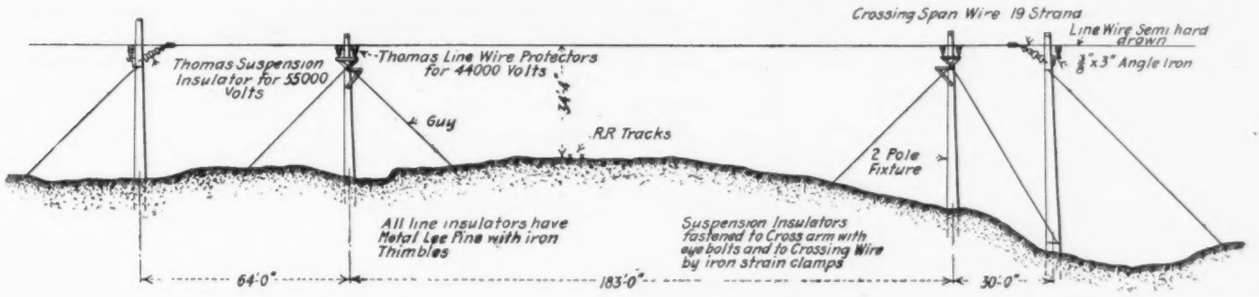

Crossing Span Wire 19 Strand
Line Wire Semi hard drawn
Thomas Suspension Insulator for 55000 Volts
Thomas Line Wire Protectors for 44000 Volts
3/8" x 3" Angle Iron
Guy
34'-4"
R.R Tracks
2 Pole Fixture
All line insulators have Metal Lee Pins with iron Thimbles
Suspension Insulators fastened to Cross arm with eye bolts and to Crossing Wire by iron strain clamps
64'-0"
183'-0"
30'-0"

FIG. 19—TYPICAL TRANSMISSION-LINE CONSTRUCTION OVER RAILROAD CROSSING

equipped with grounding strips of a carrying capacity equal to the line wire.

Special towers are in use at the Bonny Eagle station where the outgoing lines leave the plant and cross the river gorge. A typical tower is of A-frame construction, mounted on four concrete foundations 8 ft. deep and provided with two cross-pieces at the top built of 6-in. by 8-in. channel irons, carrying line insulators 30 in. apart horizontally and 31 ft. high over all. The horizontal members of the framing are built of two 2.5-in. by 2-in. by 0.25-in. steel angles, and the uprights are of 3-in. by 3-in. by ¼-in. angles, diagonal braces being of the same size as the horizontal members.

About 5 ft. below the lower cross-arm on wooden pole lines is carried a telephone circuit used by station operators, linemen and officials of the generating department. At twenty-two points on the transmission system telephone switch boxes with spare insulators are installed on the poles, and at each box a spare four-pin and a two-pin cross-arm are wired to the pole for emergency use. A step block about 12 in. by 18 in. in size is mounted on a pole stub to protect the telephone user, who plugs in a portable set at the switch box when he desires to talk. The wiring is so arranged that if either of two switches is closed the inspector can talk with the station, the absence of a permanent telephone instrument in the box eliminating any bridging circuit across the line. Only when the inspector is telephoning with his portable set is there any contact across the line. This plan of testing out sections of the telephone line is of the greatest value in cases of operating troubles.

Operation of Transmission Lines

There are about 90.5 miles of 38,000-volt line on the system. The handling of these lines has been worked out with great care to avoid accidents in restoring service in case of interruptions. Linemen are not allowed to leave the telephone when requesting a station operator to open a line until notified by the operator that the circuit ordered out has been opened, and when ordering back a circuit the original person who ordered the circuit killed is obliged to communicate with the station operator in charge. Only the head of the department in which the person ordering a circuit killed is working has authority to order a circuit restored, in addition to the person originally calling for the open circuit. All arc circuits are considered alive after 3.30 p. m. No circuit can be cut off which feeds to or from the Sewall Street substation without notifying the operator in charge. Prompt reports are required to station opera-

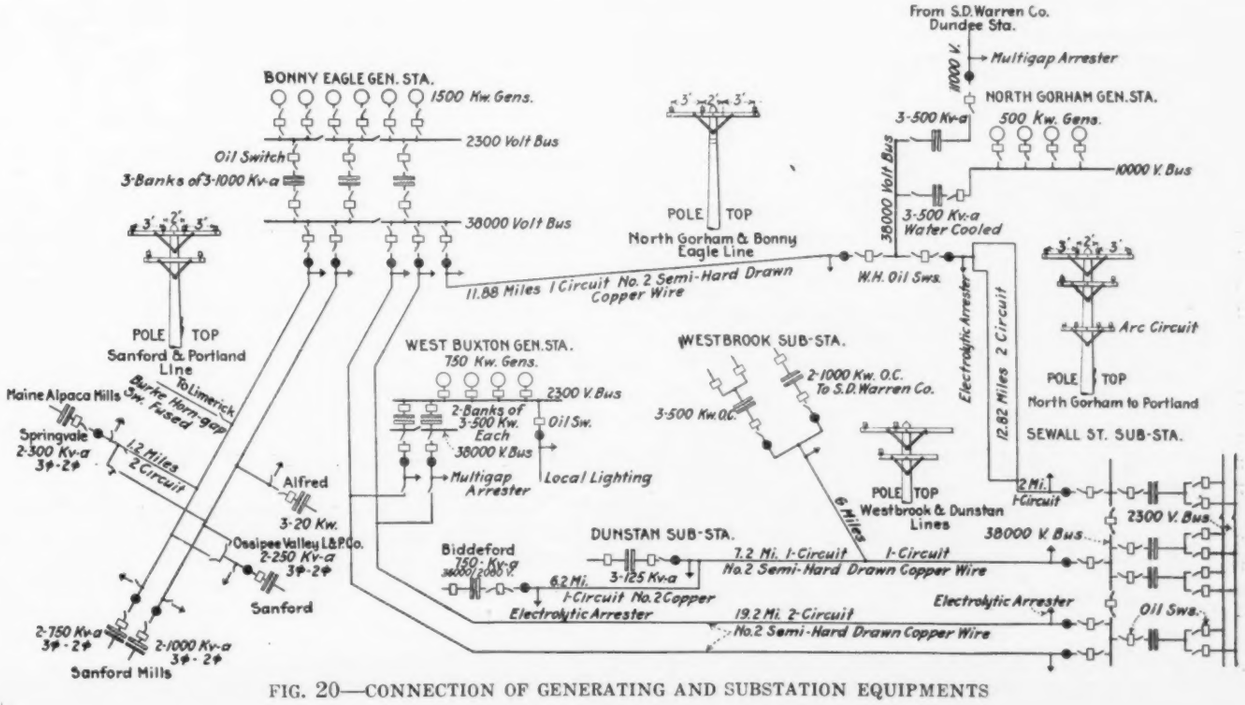


FIG. 20—CONNECTION OF GENERATING AND SUBSTATION EQUIPMENTS

tors on the completion of any work requiring the opening of circuits. Operators at substations are not allowed to volunteer information as to the location of circuits when these are ordered out of commission by linemen or others. Full record is kept of the responsibility for circuits ordered in and out.

At Bonny Eagle the normal operation of all Portland lines is with these tied together, relays being set to

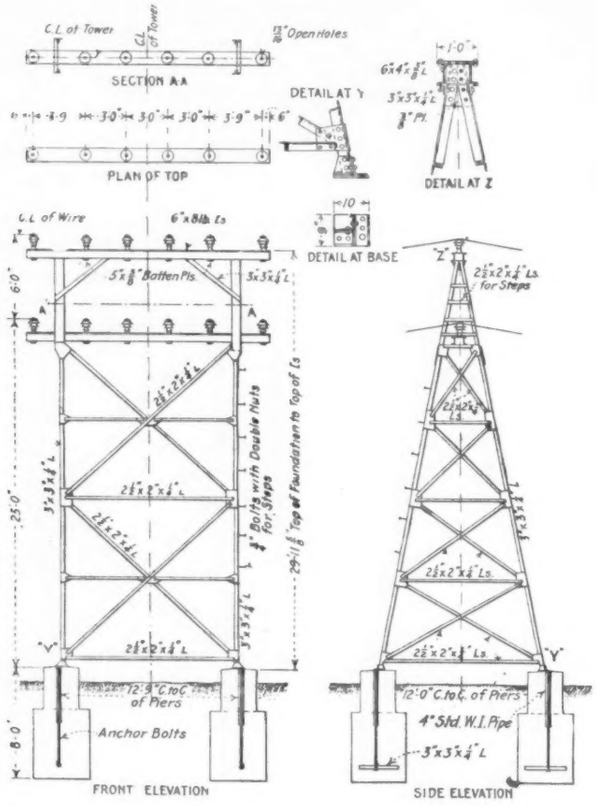


FIG. 21—CONSTRUCTION OF TOWER SUPPORTING LINES LEAVING STATION

operate on all the lines at all stations. In case of a short-circuit on any line the relays are designed to trip at both ends, clearing the trouble. If the operator finds the trouble to be on either of the Portland-Buxton lines, the line which trips out is left out until by telephone it is learned that the circuit is again working. In case both lines go out, the operator proceeds as in the case of a short-circuit on the tie line, leaving the switches out and working as follows: A voltage test is made to find out if the line is all right; the tie line is then tested with electricity from the North Gorham end, voltage being held on three minutes and then removed. When the station operator at Bonny Eagle finds the line dead after having been alive three minutes, he closes the tie-line switch and North Gorham phases in. In case the relays fail to operate, the tie-line switch at Bonny Eagle is opened. If this does not clear the trouble, it is closed, and No. 1 and No. 2 Portland-Buxton lines are successively opened. If neither clears the trouble, both are opened and left dead until outside adjustments or repairs are effected.

All telephone circuits are equipped with high-tension switches at generating stations and substations. In case of a transmission telephone-line interruption these switches are opened and repairs made at once on the instruments. At the end of ten minutes, when all power tests of the transmission lines will have ended, the operator at Bonny Eagle gets into touch with West Buxton.

In case of trouble on the Sanford lines, relays at Bonny Eagle are designed to open, and the line switches are left open for five minutes. During this time the operator endeavors to get into touch by telephone with either the substation at Sanford Mills or the Ossipee Valley Light & Power Company and learn the cause of the trouble. At the end of five minutes, or as soon as advised from Sanford, the switch on No. 1 line is closed, followed by No. 2 line. Any clear line is left in circuit. If the trouble has not cleared itself within thirty minutes, the line switches cannot be closed again until instructions have been received to this effect. Line switches held open for any reason are tagged with data cards. In all cases except emergencies, when circuits are ordered opened these cards must be filled out before opening the line.

At West Buxton in case the circuit-breakers on one line trip out no test is made, but the station supplies energy to the other line until telephone communication is established. In case both lines are opened the operator tests for voltage, and if none is found the lines are separately tested with power, leaving the good line alive for three minutes, after which it is opened, again tested for voltage, and if the latter is found is phased in.

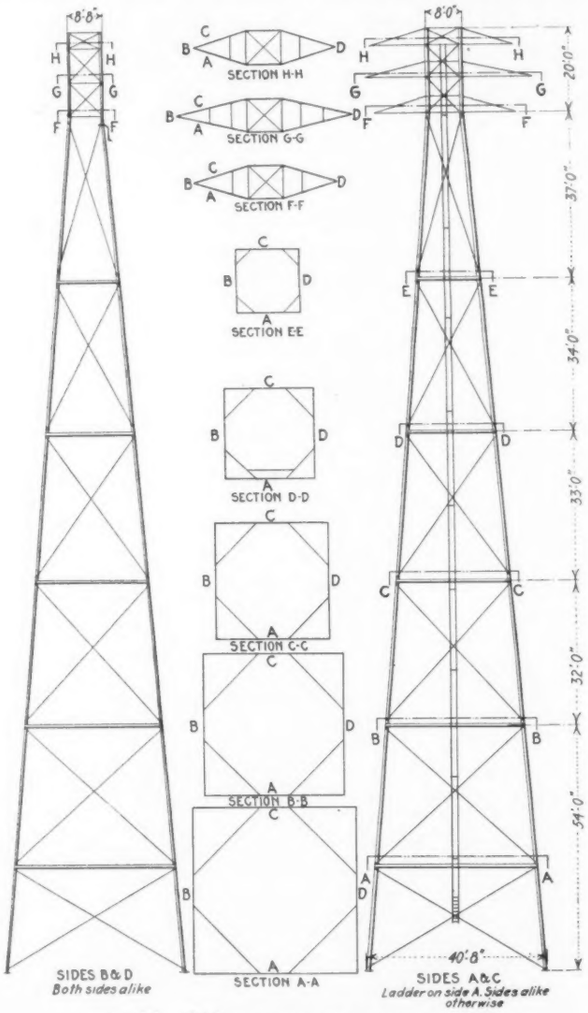


FIG. 22—210-FT. TRANSMISSION TOWER

This three-minute test with power shows the Bonny Eagle operator that the line is in condition for service. The procedure in case of a line interruption is much the same as at Bonny Eagle, all tests being completed within ten minutes. Efforts are made to get in touch with the Sewall Street substation in case of interrupted transmission. At North Gorham, in case of a short-circuit which opens the station switch, the operator tests the

high-tension line for voltage. If no voltage shows on the line, the Bonny Eagle tie line is cut open and the Portland line tested. The latter is then opened and the Bonny Eagle end is tested. If it is found clear, it is left alive for three minutes and the circuit killed. This enables the Bonny Eagle operator to learn that the line is in proper condition, after which phasing in follows as in the cases previously described.

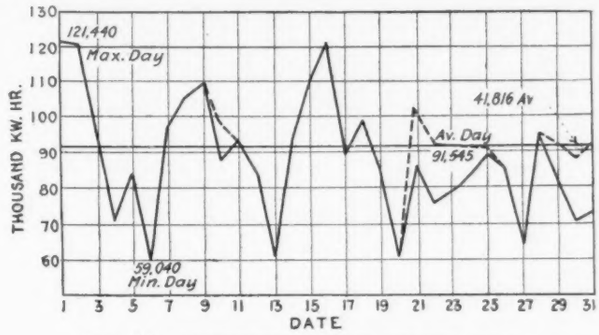


FIG. 23—COMBINED OUTPUT DURING JULY

In case of trouble on the Bonny Eagle-West Buxton-Sewall Street lines causing both switches to open the procedure at the Sewall Street substation is as follows: The operator at Sewall Street sectionalizes the high-tension bus. Each line is tested for voltage, opening one and closing the other at short intervals until the pilot lamps indicate that the circuit is alive, when the operator synchronizes the substation buses on the low-tension side, having first transferred the so-called No. 1 transformer bank, opposite the West Buxton lines, to

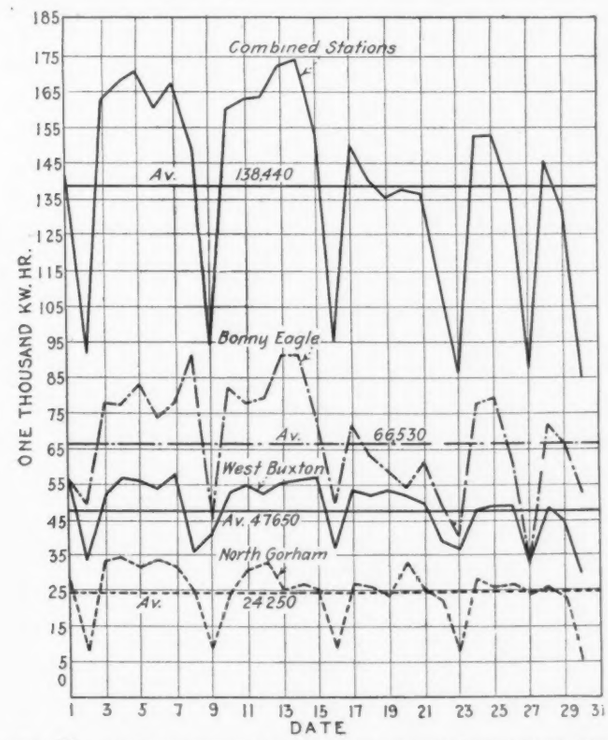


FIG. 24—OUTPUT CURVES FOR EACH STATION IN NOVEMBER

the No. 2 low-tension bus. In case of trouble on these lines causing only one switch to open, the switch is not closed again until word is received from West Buxton or Bonny Eagle that the line has been tested and is ready for operation. A corresponding procedure is followed in case of trouble on the North Gorham line, sectionalizing the high-tension bus and transferring the transformer secondary connections to the auxiliary low-tension bus prior to testing. High-tension bus sectionalization is effected by the operator in case the reverse-power relays fail to operate in the event of trouble on the transmission lines, the latter being tested for voltage as usual. All feeder circuits and tie lines are operated normally from one low-tension bus, leaving the other ready for emergency service.

Low power-factor is relieved either by readjustment

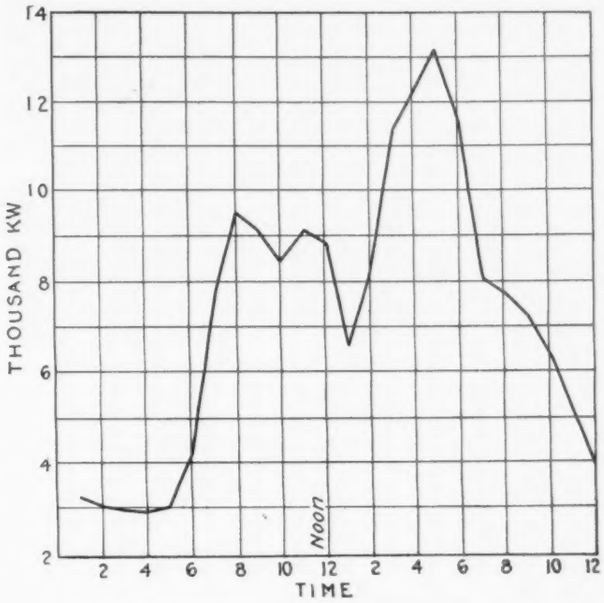


FIG. 25—LOAD CURVE FOR NOVEMBER DAY

of load conditions among the generating stations through telephonic arrangement or by stiffening the excitation of the fields in the substations operating the railway motor-generators, care being taken in the latter cases not to exceed the full-load excitation of the fields. Complete arrangements are in vogue relative to starting the fires under the boilers in the steam plants in case of notification of approaching thunderstorms near the hydroelectric stations, in the event of forest

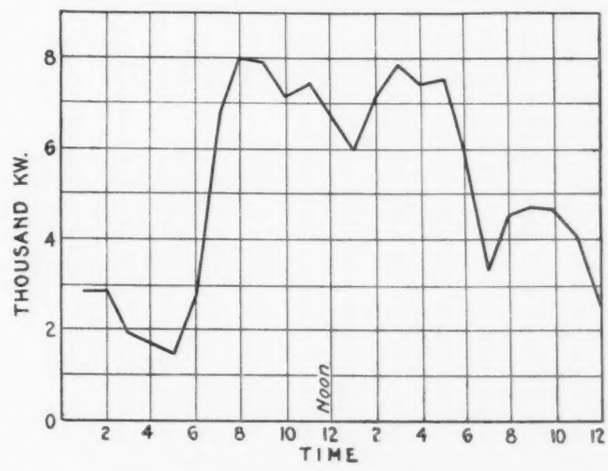


FIG. 26—LOAD CURVE FOR JULY 1

fires, voluntary shut-downs of transmission lines which cannot be restored to duty within thirty minutes, etc. Linemen doing work upon any transmission line are required to keep a portable telephone instrument tapped on the line so that they may be called from the station should it become necessary to put the line into operation at any time. Complete instructions regarding the handling of the transmission system have been prepared

in the form of a booklet by the electrical engineer of the company, Mr. W. C. Billings, for the use of linemen and station operators.

Complete log sheets are maintained at all stations, and the results are plotted in curve form and filed in loose-leaf at the main office. On a typical day the load-

FIG. 27—ELECTRIC SHOP, PORTLAND, MAINE

factor of the system was 61.6 per cent; the hydroelectric stations furnished all the energy required, and the total output was 101,230 kw-hr. Extensive load-curve data are maintained. The maximum load on the system in 1913 was 13,200 kw, occurring on Nov. 14. The average daily output in that month was 138,440 kw-hr., the maximum being 173,000 kw-hr. In eleven days of July, 1913, the company operated its steam stations. As a rule, about 97.5 per cent of the system output is furnished by the hydroelectric stations, and up to midsummer of 1914 it had not been necessary to operate the steam stations at all.

Commercial Notes

The commercial practice of the company is progressive and the rates are sufficiently low to attract much

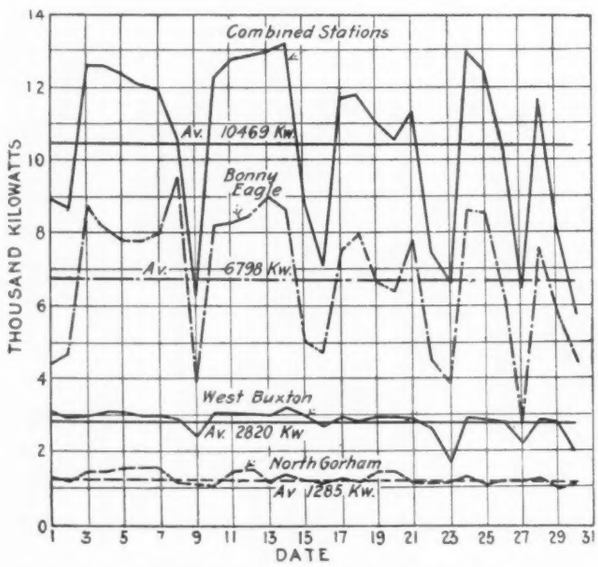


FIG. 28—PEAK-LOAD CURVES FOR EACH STATION IN NOVEMBER

new business annually. The present low rates for lighting and motor service, which compare favorably with those which prevail in similar situations in the East, are now undergoing revision with a view of substantial reduction.

The commercial salesroom is on the ground floor of the main office building in Portland, two large stores being thrown into one to serve as salesroom and trolley waiting-room. This brings a large number of people in direct contact with the large stock of appliances who ordinarily would give them no attention. In the basement is a well-fitted meeting-room for the solicitors, containing charts showing record of each salesman, diagrams of load added, etc. Offices for the motor-service solicitors are also provided here.

In a recent canvass of residences the company found that of 8600 houses 42 per cent were using electricity. The canvass was made by high-school boys at a cost of 1.5 cents per house carded. Index records were made

DAILY STATION STATISTICS

Day of week, Tuesday. Date, July 28, 1914. Weather, Cloudy.

	This Year	Last Year
Bonnie Eagle station:		
Total output in kilowatt-hours	39,300	28,100
Maximum load in kilowatts	3,350	2,900
Ratio average load to maximum	48.9	40.3
Ratio average to station rating	18.2	13.0
Average head in feet	39.1	36.7
Maximum river elevation	147.4	147.0
Minimum river elevation	146.9	143.8
West Buxton station:		
Total output in kilowatt-hours	30,430	25,680
Maximum load in kilowatts	2,260	1,650
Ratio average load to maximum	56.2	64.8
Ratio average to station rating	42.3	35.7
Average discharge in cubic second feet	1,022	868
Average head, in feet	27.4	27
Maximum river elevation	108.3	107.5
Minimum river elevation	107.2	107
North Gorham station:		
Total output in kilowatt-hours	31,500	28,400
Maximum load in kilowatts	1,500	1,450
Ratio average load to maximum	87.4	81.5
Ratio average to station rating	65.6	59
Average discharge in cubic second-feet	758	667
Average head, in feet	33	34.2
Maximum river elevation	223.80	224.85
Minimum river elevation	223.48	224.15
Combined hydroelectric stations:		
Total output in kilowatt-hours	101,230	82,180
Maximum load in kilowatts	6,850	5,910
Ratio average load to maximum	61.6	57.9
Ratio average to station rating	30.2	24.4
Forest Avenue station:		
Total output in kilowatt-hours	.....	10,715
Maximum load in kilowatts	.....	1,155
Tons of coal burned	.....	20.2
Plum Street station:		
Total output in kilowatt-hours	.....	.....
Maximum load in kilowatts	.....	.....
Tons of coal burned	.....	6.7
All Stations:		
Total output in kilowatt-hours	101,230	92,895
Maximum load in kilowatts	6,850	6,405
Ratio average load to maximum	61.6	60.4
Ratio average to station rating	20.1	18.4

showing the data gathered by these visits, the use of gas, electric irons, wired or unwired condition of buildings, the use of toasters and other appliances. The canvass was conducted in July, 1914, and took about three weeks.

Among the large customers of the company are the Sanford Mills, taking 2500 hp; the Portland Company, 600 hp; Bancroft & Martin steel foundry, 350 hp; Casco Tannery, 250 hp; Grand Trunk Railroad shops, 100 hp, and various brick yards, newspaper offices, etc. The principal hotels are on central-station service, and, as stated, the electric-railway lines consume a large proportion of the total output yearly. The Union Station, Maine General Hospital, Sen Sen Chicklet Company, and other consumers are among the company's patrons.

The officers of the company are: President, Mr. William M. Bradley, Portland, Maine; vice-presidents, Messrs. A. H. Ford, Portland, and Frank Silliman, Jr., Philadelphia; general manager, Mr. A. H. Ford, Portland; treasurer, Mr. C. Fred Berry, Portland; assistant treasurer, Mr. Wilbur Tusch, New York; executive committee, Messrs. W. M. Bradley, John R. Graham, Frank Silliman, Jr., H. L. Clark and P. G. Gossler.

The Selective Time Element of Relays

Data Necessary in Predetermining the Setting of Relays—Types of Time-Element Mechanisms—Testing Accurate Relays

BY PAUL MACGAHAN

THE modern idea with reference to relays is to insure continuity of service, to protect against loss of synchronous load, and by selective timing action to disconnect only such portions of the circuits as are in trouble, with a minimum disturbance—in fact, without disturbing any other service than that necessary to isolate a defective cable or feeder. In some cases more than one route is provided for the energy to reach the point of application—such as by means of tie lines, parallel feeders, ring-connected feeders, etc.—and the relays are relied upon to select and disconnect only the defective sections.

Preliminary Data in the Setting of Relays

In order to predetermine the proper settings for the various relays in a system of distribution, the characteristics of the generators and of the system must be known, as well as the characteristics of the automatic apparatus, circuit-breakers, regulators, etc. In general,

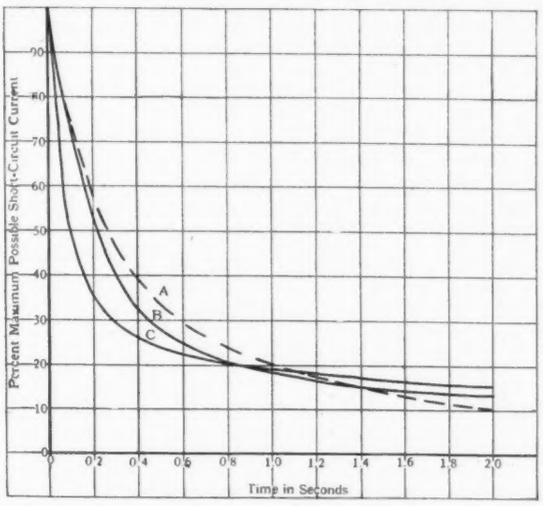


FIG. 1—RATE OF CURRENT DECREASE UNDER CONDITIONS OF MAXIMUM SHORT-CIRCUIT FOR THREE GENERATORS

before proceeding to set the time elements of relays the following information is necessary:

(1) The "instantaneous" short-circuit value of the current through each conductor to which the relays may be applied.

(2) The "sustained" short-circuit value of the current through each conductor.

(3) The time in changing from 1 to 2.

(4) The time required for the various automatic circuit-breakers to open the circuit after the application of current to their coils.

(5) The safe circuit-opening capacities of the various circuit-breakers.

(6) The time characteristics of the various relays.

(7) The probability and amount of reversal of flow of energy, in the case of circuits operated in parallel.

The values of the short-circuit currents depend partially upon the characteristics of the generator used and partially upon the impedance of the circuit to the point to which the relays are connected. The further the point of application is from the generator, and the more apparatus is included between the point in question and the generator, the less will be the difference between the instantaneous short-circuit value 1 and the sustained short-circuit value 2. The time elapsing for the current to decrease from condition 1 to condition 2 is shown for certain generators in Fig. 1, from which it is seen that for the particular generators tested the currents can be taken as having decreased to one-fifth of the initial short-circuit value 1 inside of one second. Other generators may show a greater divergence in this respect.

The current wave at short-circuit may be symmetrical or unsymmetrical up to 0.15 second or 0.25 second, depending upon the point of the voltage wave at which the short-circuit is closed, and the initial rate of decrease is greatly affected by the degree of dissymmetry. After this time the current wave is symmetrical and the rate of decrease is practically the same regardless of the degree of dissymmetry during the first few cycles. The sum of the positive and negative peak values of the first current cycle of a short-circuit is approximately the same for any given machine and voltage. The rate

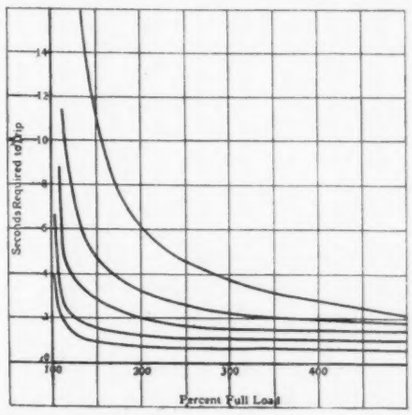


FIG. 2—CHARACTERISTIC TIME CURVE OF AN INVERSE-TYPE BELLOWS RELAY

of decrease is materially faster during a single-phase short-circuit than during a three-phase short-circuit on any given machine, although the sustained single-phase short-circuit current is about 50 per cent greater than the sustained three-phase short-circuit current for equal field currents.

These tests represent a condition of constant field current during the entire time of short-circuit such as would be obtained on an unloaded machine without an automatic voltage regulator. Equipped with a regulator, the field current will be increased approximately to from two to four times its no-load value, which in turn will increase the sustained current in proportion to the increase of field current. It is believed that the presence of a regulator on a machine will have no appreciable effect on the instantaneous-current values during the unsymmetrical period of short-circuit.

In general, the "time elements" of relays should be as short as possible without jeopardizing the selective action and continuity of service, or without causing the circuit-breakers to open before a "short-circuit" current has died down to a value that can be safely opened by

*Detail and Supply Engineering Department, Westinghouse Electric & Manufacturing Company.

the circuit-breaker. This last consideration is one of expediency only, for in order to get the best results the circuit-breakers should be of sufficient capacity to do their part in the general protective scheme found desirable for the system. Thus in selecting the proper circuit-breakers it should be borne in mind that the ratings of circuit-breakers are often arranged according to

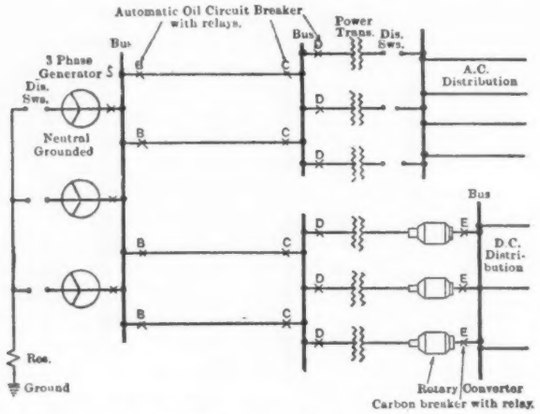


FIG. 3—TYPICAL GENERATING AND DISTRIBUTING SYSTEM WITH PROTECTIVE CIRCUIT-BREAKERS

whether or not they are to be called upon to trip instantaneously or after the sustained short-circuit value of current is established. In the case of radial feeders it may be that the more remote switches would be required to have actually greater capacity than those nearer the generating end, so that they can be timed to go out more quickly.

In line with the later developments in the practice of relay applications, it becomes of paramount importance to have a relay the time-element mechanism of which is positive, reliable and accurate. The accuracy of the adjustment of current value required to trip is not a matter of great concern, for when a short-circuit occurs the current setting of the relays is exceeded by at least several hundred per cent. This is especially true in systems of large generating capacity.

Types of Time-Element Mechanisms

The time-element devices in relays in most general use consist of either the bellows type or the induction type with magnets acting to "damp" the motion of a disk. In other words, the damping may be either mechanical or electrical. In addition to bellows time-element devices and magnets acting upon wattmeter disks, dashpots and clock-work escapements have been used in the past, but have been found unsatisfactory in accuracy or reliability except for special purposes and will accordingly not be considered. The bellows time-element relay was one of the direct products of the old ideas as to relay settings. These relays are still the most generally known means of giving time elements to overload protective devices, and are made by several manufacturers, in the "inverse" type or the "definite" type. Fig. 2 shows a characteristic time curve of an "inverse" bellows relay, and Fig. 4 shows the time-element action of a "definite" time relay.

In all bellows relays the time-element device consists essentially of an electromagnet, a core, contacts actuated by the core when it completes its stroke, and a delaying mechanism consisting of a leather bellows, having a "needle valve" or vent for ejection of the air at a supposedly predetermined rate.

In the "inverse" time-element relay the core acts directly to compress the bellows, carrying the contact member with it; thus the greater the overload, the shorter the time.

In the "definite" time-element relay a spring is interposed between the core and the bellows so that when the current setting it exceeded the core rises instantaneously, thereby compressing the bellows spring. The latter then expands, compressing the bellows at a rate independent of the amount of overload. Owing to the necessity for making this intermediate spring fairly strong, in order to insure good contact, the lower overloads show an inverse time characteristic in the "definite" relay (Fig. 4), which rapidly reaches a definite time value at higher overloads.

Although mechanically damped relays are satisfactory for protection against overloads—that is, protecting apparatus from overheating where the amount of time element is not important—it should be remarked that they were designed at a time when the idea of selective protection was not yet developed. Accordingly they do not have a sufficient accuracy of time setting for use where selective protection is desired. The lack of accuracy is due to the following variations, all well known to station engineers and operators:

(1) Variations in the bellows leather, due to weather, stiffening, dampening, etc.

(2) Variations in the amount of air contained, due to the time which has elapsed since previous overload.

(3) Variations due to dirt or rust in the needle valve.

(4) Variations due to the impossibility of close adjustment of the needle valve.

(5) Variations due to vibration or chattering from pulsations of the alternating-current electromagnet core.

(6) Variations due to friction of the various moving parts.

In addition to the above shortcomings, the "inverse" time-element bellows relays have the very unfortunate characteristic (so far as selective protection is concerned) of becoming instantaneous at heavy overloads. This prevents the use of these relays where it is desired to trip only the circuit nearest to the fault. For example, in Fig. 3, assume a short-circuit on the alternating-current distribution feeders, the whole system being equipped with bellows relays. The short-circuit is in general of sufficient magnitude to cause all the relays from the fault to the source of supply to become practically instantaneous, and thus any of the relays is liable to trip out, instead of only the one nearest the fault. If, however, each relay is provided with a time-element device which operates with a definite minimum delay, no matter how high an overload, the procedure would be to set the time-element device of the most remote circuit-breaker to the lowest delay desired, and to adjust the

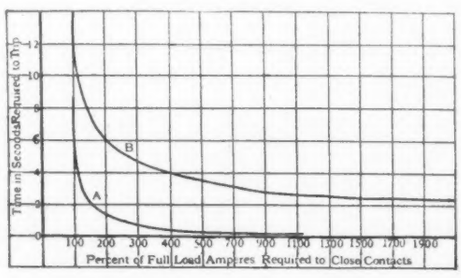


FIG. 4—CURVES SHOWING THE EFFECT OF THE TORQUE COMPENSATOR ON THE INDUCTION-TYPE RELAY

delay element of each succeeding circuit-breaker toward the source of supply to a slightly greater time. Thus no more circuit-breakers would go out than absolutely necessary to disconnect the defective section.

The time interval between successive circuit-breakers should be equal to the time taken for the circuit-breaker to open the arc plus a margin of safety to include vari-

ations in the timing of relays. This margin must be about one second, to be perfectly safe, when using bellows relays under best conditions. Thus, if there are several sections in series and the trouble should be near the generating end, the short-circuit may not be cleared off for eight or nine seconds, which would, of course, mean the loss of all synchronous loads on the system.

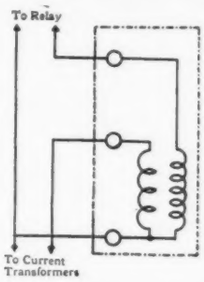


FIG. 5—CONNECTIONS FOR TORQUE COMPENSATOR

Much more accurate timing can be obtained by means of relays which depend upon the damping action of a permanent magnet upon an aluminum disk, evidently giving as great an order of accuracy as in the calibration of watt-hour meters. The disadvantage of induction relays made in this way in the past has been that, owing to the fact that the driving force is proportional to the square of the current, and the speed of the disk when damped by a magnet is proportional to the driving force, the time curve reaches an instantaneous value at about five times the full-load current, which, of course, precludes application to cases where selective protection is desired.

In order to overcome this disadvantage use is made of a device known as a "torque compensator," consisting of a miniature transformer connected between the coil of the relay and the series transformer on the line. This small transformer has a laminated sheet-steel core of such cross-section that it begins to saturate as soon as the current increases beyond the normal operating load. This prevents the secondary current, which passes through the relay coils, from increasing at the same rate as the primary current, or beyond a certain final limit. Thus the "torque" of the relay is no longer proportional to the square of the current, and the time curve is modified, as shown in Fig. 4. It will be noted that, no

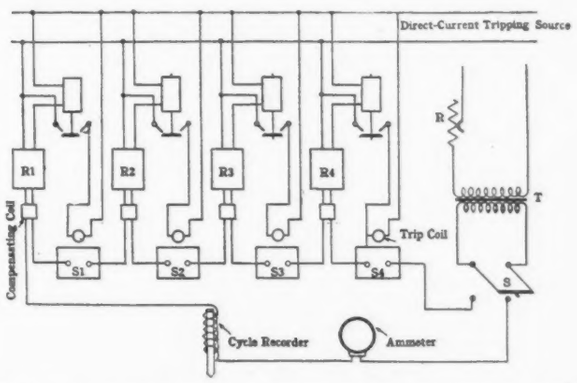


FIG. 6—CONNECTIONS FOR TESTING THE SELECTIVE ACTION OF TIME-ELEMENT RELAYS

matter how heavy the load, a definite delay of two seconds can be obtained. An adjustment of the contact position inside of the relay allows a setting for any value of time, at heavy overloads, below the limit shown.

Although an external torque compensator is desirable for use with induction-type relays already installed, where it is necessary to obtain selective action at high overloads, in the case of new installations it would be preferable to use a torque compensator contained in the same case with the relay. This relay consists of a watt-hour-meter case, frame, movement and magnets, the coils being wound for current only, and the contact mechanism being mounted on the shaft. A spring is used to return the movement to the normal position.

The accuracy of time setting obtainable with these devices is just as high as the accuracy of watt-hour meters. In fact, these relays may be counted upon to reproduce their time settings with repeated applications of any given overload within an error of approximately one cycle, on a sixty-cycle system, or within one-half cycle on a twenty-five-cycle system. If the overload should be cleared off approximately one cycle before any relay has completed its stroke, the relay will not close the contact, but will immediately reset itself to its normal position. The normal position of the disk and movable contact, under normal operating loads, is against a fixed stop, the position of which is regulated according to the timing desired. In tests carried out on these relays four circuit-breakers were operated in series, each requiring 0.28 second for breaking the arc, and each relay adjusted to trip at a minimum current of 10 amp, the time adjustments of the relays being respectively 0.08, 0.50, 0.92 and 1.34 second under short-circuit conditions, the connections being as in Fig. 6. Application of overload current of any value would cause only circuit-breaker No. 1 to open; with No. 1 blocked only No. 2 would open, etc., even when the current was raised to 1000 per cent or more, showing that the selective action was perfect under all overload conditions. In practice the relay switches shown in this test as taking 0.08 second to operate would not be required, as the difference between successive relay time settings could be kept approximately within one-tenth of a second in excess of the time required for each circuit-breaker to open its arc. As the length of time required to clear a current has an important bearing upon the chances of retaining synchronous loads on other circuits, the ability to use such close margins in the settings of relays is very important.

Testing Accurate Relays

In testing relays having these high-accuracy timing characteristics ordinary stop watches are inadequate, as the error of observation is much greater than the error of the relay. The best results are obtained by the use of a "cycle recorder," a device actuated directly by the alternations of the circuit passing through the relay coils, and having an arrangement to stop its motion as soon as the contacts of the relay close.

Motors and Powdered Coal to Replace Gas

A glass furnace heated with gas will consume about $40 worth of fuel a day when operating at full rated output, and in some districts the glass companies have been good customers of the gas companies. At Tiffin, Ohio, the United States Glass Company has installed and is operating electrical machinery which it hopes will enable the company to substitute coal as a fuel in place of gas. In brief, the apparatus consists of a 35-hp motor driving a coal pulverizer, a 10-hp motor driving a blower, and a 5-hp motor driving a hoist. With this equipment it is thought that it will be possible to pulverize coal and blow it under the furnaces, igniting it as it enters, thereby reducing the aggregate cost of fuel and eliminating the annual necessity of shutting down in midwinter when the gas supply is low. The glass company is purchasing its electrical energy from the Ohio Light & Power Company.

CENSUS OF EMPLOYEES AND WAGES

Commercial Central Stations Have 90 per Cent of Those Engaged in the Industry

The United States Census report on employees, salaries and wages of electric central stations in 1912 shows large increases for both commercial and municipal plants. The value of the comparison with earlier years is reduced somewhat by differences in the bases of the compilations in the different census periods.

Table I, which is published herewith, shows employees, salaries and wages of commercial and municipal stations for the three census periods. Where the total number of employees increased from 1902 to 1912 in both classes of plants 161.6 per cent, the increase for commercial plants was 165.3 per cent and for municipal 132.4 per cent. Salaries and wages increased in the decade 196.2 per cent for both classes, or 196.6 per cent for the commercial and 192.8 per cent for the municipal. Officers of corporations increased in the decade 54 per cent in number and 162 per cent in salaries, all of this representing commercial plants in the returns. Superintendents and managers increased in the decade 86.9 per cent in number and 161.3 per cent in salaries; these figures represent an increase of 93.5 per cent in number and 158.4 per cent in salaries for commercial plants and of 68.8 per cent in number and 176.3 per cent in salaries for municipal plants. Clerks, stenographers and other salaried employees increased in the decade 534 per cent in number and 714.6 per cent in salaries; commercial plants showed an increase of 555.8 per cent in number and 711 per cent in salaries of such employees, and municipal plants increased 319.5 per cent in number and 807.6 per cent in salaries for the same class. Wage earners increased for both classes of plants 128.2 per cent in average number and 146 per cent in wages; commercial plants showed 127.8 per cent increase in average number and 143.5 per cent increase in wages for this class, and municipal plants increased 132 per cent in average number and 169.5 per cent in wages.

TABLE I—COMMERCIAL AND MUNICIPAL STATIONS—EMPLOYEES, SALARIES AND WAGES

	Commercial			Municipal		
	1912	1907	1902	1912	1907	1902
Total:						
Number	71,395	42,066	26,909	7,940	5,566	3,417
Salaries and wages	$55,658,515	$31,935,309	$18,766,970	$5,503,426	$3,485,015	$1,879,722
Salaried employees:						
Officers of corporations—						
Number	2,181	1,761	1,416	.....	.....	.....
Salaries	$3,839,136	$2,202,028	$1,465,471	.....	.....	.....
Superintendents and managers—						
Number	3,629	3,268	1,875	1,163	1,089	689
Salaries	$5,397,004	$4,243,307	$2,088,298	$1,085,745	$814,929	$392,980
Clerks, stenographers, and other salaried employees—						
Number	18,067	6,346	2,755	1,053	526	261
Salaries	$13,400,937	$4,293,620	$1,652,430	$584,482	$179,903	$64,401
Wage earners:						
Average number	*47,518	30,691	20,863	*5,724	3,951	2,467
Wages	$33,021,438	$21,196,354	$13,560,771	$3,833,199	$2,490,183	$1,422,341

*Number Sept. 16, or nearest representative day.

The largest number of employees in any state in 1912 was reported for New York, 13,733, with salaries and wages of $11,034,898. Illinois was next with 8036 employees and $6,223,882 salaries and wages. Pennsylvania paid 7300 employees $5,098,265; California, 5738 employees, $5,823,203; Massachusetts, 3954 employees, $2,981,043; Michigan, 3876 employees, $2,843,371.

Where the number of employees for both classes of stations increased 57 per cent from 1902 to 1907 the increase in the succeeding period of five years was 66.6 per cent. Of the total for 1912, 26,093, or 32.9 per cent, were salaried employees; their salaries, $24,307,304, were 39.7 per cent of the total annual salaries and wages. The wage earners formed 67.1 per cent of the total employees and their wages 60.3 per cent of the total. Commercial stations had 90 per cent of the total number of salaried persons and wage earners engaged in the industry. For the municipal stations 2216 salaried employees were reported, or 27.9 per cent of the total, with salaries of $1,670,227, or 30.3 per cent of the total for this class of plants. The average number of persons per central station in 1912 was 15.2, as compared with 10.1 for 1907 and 8.4 for 1902.

TABLE II—OUTPUT OF CENTRAL ELECTRIC STATIONS AND AVERAGE OUTPUT PER EMPLOYEE, BY GEOGRAPHIC DIVISIONS

Division	Census	Number of Persons Employed	Output of Stations	
			Total Kilowatt-Hours	Average per Employee
United States	1912	79,335	11,532,963,006	145,370
	1907	47,632	5,862,276,737	123,074
	1902	30,326	2,507,051,115	82,670
New England	1912	7,352	879,272,535	119,596
Middle Atlantic	1912	24,022	3,548,605,305	147,723
East North Central	1912	19,233	2,527,964,097	131,439
West North Central	1912	7,892	712,595,442	90,293
South Atlantic	1912	4,317	679,856,425	157,484
East South Central	1912	2,426	227,664,808	93,844
West South Central	1912	3,655	233,947,656	64,008
Mountain	1912	3,090	845,393,882	273,590
Pacific	1912	7,348	1,877,662,856	255,534

The percentages of increase in number of employees and salaries and wages in the decade from 1902 to 1912 were much the largest for the Pacific group of states. The smallest percentages of increase for these items were shown for the New England group of states. The actual increases were greatest for the Middle Atlantic division. The census classification of states was published in the ELECTRICAL WORLD of Jan. 16, 1915, page 161. In each of the nine divisions the percentage of increase in the decade was greater for salaries and wages than for number of employees. The same condition existed in all but four of the states. The smallest percentage of increase in number of employees during the decade was shown for Vermont and the smallest proportionate gain in salaries and wages for Louisiana; totals for central stations in the latter State have been decreased by the transfer of large central stations to electric railways.

Table II shows the average kilowatt-hour output per employee for the census groupings of states. Where the average output in kilowatt-hours per employee increased 48.9 per cent from 1902 to 1907, the increase in the succeeding period of five years was but 18.1 per cent. The largest averages per employee are found in the Mountain and Pacific States. The largest actual increase in the decade for any division in the average per employee, 163,151 kw-hr., and the largest percentage of increase, 147.7, are for the Mountain division. The Pacific and South Atlantic States follow in both respects in the order named. In all three of the groups of states named water-power is the predominating primary source. The average output per employee for the hydroelectric stations was 341,457 kw-hr. for 1912, as compared with 91,252 kw-hr. for all other stations reported.

Criteria for the Quality of Commutation

Examination of Those Proposed by Arnold and Hobart and of the Conditions Requisite for the Best Results

BY J. F. H. DOUGLAS

THE analytical criterion of good commutation is regarded by many to be an unimportant question, now that interpoles have come into general use. Nevertheless, it is necessary, even with interpoles, that the "sparking" voltage (which is the difference between the "reactance" voltage and the voltage induced by the interpoles) be less than a certain amount. When the reactance emf runs up to 15 volts in a machine at full load, the interpoles are likely to become saturated under heavy overloads. Consequently the sparking voltage, even in interpole machines, now approaches the permissible limit.

There have been proposed criteria for the quality of commutation which are more or less contradictory, one due to Arnold[1] and one to Hobart.[2] Arnold's criterion of commutation was deduced entirely from theoretical considerations. It is:

$$\frac{RT}{L} > 1, \qquad (1)$$

where L is the inductance of the coil in henries, T is the time of the reversal of the current in seconds, and R is the resistance of the contact between the brush and the commutator in ohms. Hobart gives the following partly empirical relation[3] as necessary for good commutation,

$$E_r = 2\pi fLI < 3 \text{ volts or } 4 \text{ volts}, \qquad (2)$$

where I is the current in each branch of the armature and $2f$ is the number of reversals of current per second, or $2f = 1/T$. The voltage E_r is called by Hobart the "reactance voltage."

Hobart's proof was needlessly encumbered with the assumption of a sine wave for the reversal of current in the short-circuited coil. The *average* reactance voltage is independent of the manner of reversal of the current. $E_{av} = 4fLI = \frac{4}{2\pi}E_r$; the limiting value of E_{av} is then from 2 volts to 3 volts, and Hobart's criterion may therefore be written

$$\frac{2LI}{T} < 2 \text{ volts or } 3 \text{ volts} \qquad (3)$$

Arnold's criterion may be put into a similar form by multiplying both sides of equation (1) by $2LI/T$, giving

$$\frac{2LI}{T} < 2IR,$$

where $2I$ is the current per brush, $2IR$ is the brush drop E_b, and $2LI/T$ is the average reactance voltage. Now, even with hard-carbon brushes, the brush drop is hardly ever greater than 1 volt or 1.5 volts, so that equation (1) is equivalent to

$$\frac{2LI}{T} < 1 \text{ volt or } 1.5 \text{ volts} \qquad (4)$$

Although each of the two writers has his own method of computing inductance, which probably gave good results in his own hands, yet when this issue is finally settled it must be admitted that the two criteria are decidedly in disagreement. It will be observed that one is approximately twice the other. While Arnold's value is surely safe and shows the effect of brush material, Hobart's empirical value must be taken as agreeing with his experience. The following critical discussion of the theory of commutation shows that there is a sound basis for Hobart's values, and it suggests points for experimental study.

The law of the reversal of current in the short-circuited coil involves a differential equation that has not as yet been completely solved. However, it is only the last few instances of reversal that are of significance, and it is possible to obtain a solution for this part of the short-circuit period. The conditions near the end of the short-circuit period are as represented by Fig. 1.

Let $2I$ be the total current in the brush, R be the brush contact resistance, i the current in the trailing tip of the brushes, A the total brush contact area, and a the area of the contact between the trailing tip of the brush and the segment it touches. The resistance of the trailing contact is RA/a, and the resistance of the

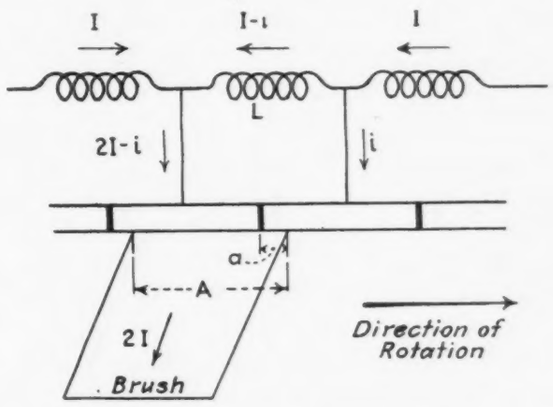


FIG. 1—PROCESS OF COMMUTATION

leading contact is $RA/(A-a)$. The current in the short-circuited coil is $I - i$ and the current in the leading tip of the brush is $2I - i$.

Applying Kirchoff's second law to the short-circuited coil gives

$$-L\frac{d(I-i)}{dt} = RA\frac{(2I-i)}{(A-a)} - RA\frac{i}{a} \qquad (5)$$

A graphical interpretation of this equation is given in Fig. 2.

For instance, near the end of the commutation period, the approximation $(2I-i)/(A-a) = 2I/A$ may be made. The velocity of the commutator is determined by the fact that the area of contact changes from O to A in the time T; consequently $da = -(A/T)dt$, or $dt = -(T/A)da$, the minus sign indicating that a decreases as t increases. Making these substitutions, equation (5) may be written

$$a\frac{di}{da} = \frac{RT}{L}\left[i - \frac{2Ia}{A}\right] \qquad (6)$$

The solution of this equation for conditions when RT/L is not equal to unity is

$$i = Ka^{(RT/L)} - \frac{2I}{A}\cdot\frac{RT}{L-RT}a \qquad (7a)$$

[1] "Die Gleichstrommaschine" (1902), Vol. I, p. 296.

[2] "Elementary Theory of Continuous-Current Dynamo Design" (1906), pp. 107, 139.

[3] A number of other criteria are referred to by Hawkins and Wallace in "The Dynamo," fifth edition, Vol. II, pp. 643-653. However, these are for the most part indefinite and difficult to apply.

when $RT/L = 1$, the solution is

$$i = Ka + \frac{2I}{A} a \log_\epsilon \left(\frac{1}{a}\right) \qquad (7b)$$

In either case the constant K is determined from the value of i at some instant just previous to the end. This will in general have to be determined graphically, when desired; but, for the purpose in hand, K may remain an unknown constant.

The current density is

$$U = \frac{i}{a} = Ka^{(RT/L-1)} - \frac{2I}{A} \cdot \frac{RT}{L-RT} \qquad (8a)$$

or

$$U = \frac{i}{a} = K + \frac{2I}{A} \log_\epsilon \left(\frac{1}{a}\right) \qquad (8b)$$

according to whether (RT/L) is different from or equal to unity. In order to have a finite current density at the end of the short-circuit—that is, when $a = o$—it is therefore seen that RT/L must be greater than unity, which is Arnold's criterion, equation (1). Arnold's criterion is therefore equivalent to the assumption that infinite current density should not be reached. On the other hand, Hobart's experience leads one to suspect the possibility of good commutation, even with an infinite current density at the end of the short-circuit.

In the opinion of the writer, a criterion of sparking more reasonable than that based upon the impossibility of infinite current density is one based upon the assumption that an infinite temperature rise cannot occur at the trailing tip of the brush. This is a more reasonable criterion because were an infinite or simply a very high temperature reached sufficient ions would certainly be produced to cause an arc or spark.[4] The most unfavorable conditions of no radiation and no conduction of heat during the last intervals of current reversal will also be assumed.

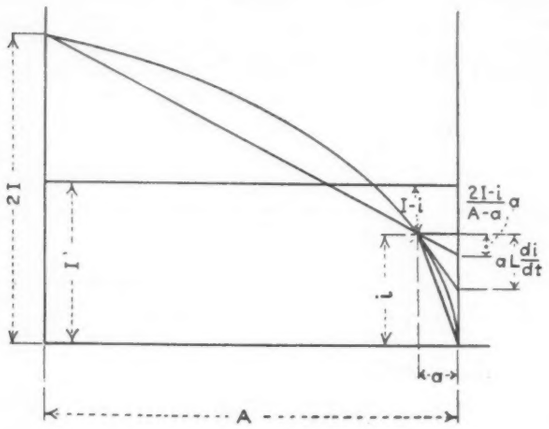


FIG. 2—CURVE OF CURRENT REVERSAL

Let s be the specific heat of the contact layer per unit width, and ρ the resistance per unit width of the contact, both assumed constant. The heat developed at the extreme edge of the brush in a width Δa in the time dt is

$$dQ = i^2 \frac{RA}{a} dt \frac{\Delta a}{a} = \left(\frac{i}{a}\right)^2 \rho \Delta a \frac{T}{A} da$$

The rise of temperature is

$$d\theta = \frac{dQ}{s(\Delta a)} = \frac{T\rho}{As}\left(\frac{i}{a}\right)^2 da$$

The current density (i/a) has two terms, the important or critical one being $Ka^{(RT/L-1)}$. Substituting this term only and integrating gives

$$\theta = \frac{T\rho K^2}{As} \int_a^o a^{(2RT/L-2)} da = c \left| \frac{a\frac{2RT}{L} - 1}{\frac{2RT}{L} - 1} \right|_a^o \qquad (9)$$

Where c is a constant, equation (9) becomes infinite when $2RT/L$ is equal to or less than unity. Hence the condition that the contact layer at the tip of the brush shall not become infinitely hot is

$$\frac{RT}{L} > \frac{1}{2} \qquad (10)$$

Of course, no other part of the brush is so hot as this part, and the temperatures equalize during the first part of the cycle.

The above condition for good commutation is equivalent to an average reactance emf of from 2 volts to 3 volts, since the brush-contact resistance drop is from 1 volt to 1.5 volts. Whence equation (10) is equivalent to the condition

$$\frac{2LI}{T} < 2 \text{ volts or } 3 \text{ volts}, \qquad (11)$$

which agrees with Hobart's value, equation (3).

Cases Where Above Relations Do Not Hold

In case the specific heat or the resistivity of the brush contact is a variable, the above relations will no longer hold. Only two cases have been investigated by the writer. In the first case it was assumed that the resistivity and specific heat were functions of the temperature only. This assumption leads to the same limiting value of RT/L as given by equation (10). The second case studied was that of a constant specific heat, but a resistivity varying only with the current, and that according to some inverse power. The results were as follows:

If

$$\rho = \frac{K}{\sqrt[m]{i}},$$

then

$$\frac{RT}{L} > \frac{1}{1+m},$$

or

$$E_{av} < (1+m)E_b, \qquad (12)$$

where E_b is the brush-contact resistance drop.

It would be of value to determine from experiment the law of reversal of current during the last intervals of commutation. It would be of interest, also, to determine whether the resistance is a function of the temperature or of the current.[5] Another experimental research in this connection would involve tests made upon a combination of resistances and inductances which would imitate the conditions in a machine. The advantages of such a test would be flexibility of adjustment, possibility of having only a few segments, and a comparatively long time for the reversal of current.

[4] Hawkins and Wallace, "The Dynamo," Vol. II, p. 644, quote E. Arnold and J. L. LaCour's paper, read before the International Electrical Congress at St. Louis, 1904, as proposing as a criterion of sparking the average watts developed at the edge of the brush. While not identical with the criterion here suggested, this proposal suggests the need of a physical criterion involving energy. The method outlined by the authors referred to is difficult to apply.

[5] Some experiments in this connection are quoted by Hawkins and Wallace, "The Dynamo," Vol. II, pp. 600-608. From the material there given it seems probable that equation (11) is a better criterion of commutation than equation (12).

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

Resistors with Negative Temperature Resistance Coefficient for Rotors of Induction Motors.—A note on a recent British patent (No. 590, 1914) of G. Mascarini and A. Contardi. Resistors containing sulphide of iron or similar materials have a high negative temperature-resistance coefficient and, according to this invention, when applied to the rotor of induction motors give automatically the required decrease of resistance as they become warm. The resistors can be made very compact and be embodied in the rotor, so that only an internal short-circuiting switch but not slip-rings are required.—London *Elec. Eng'ing*, Feb. 11, 1915.

Heating of Field Coils.—MAGNUS MACLEAN, D. J. MACKELLAR AND R. S. BEGG.—A note on a recent paper read before the Scottish local section of the (British) Institution of Electrical Engineers on research into the distribution of temperature rise in field coils. In one of the field coils of a motor several thermo-junctions were inserted at various depths, and curves were plotted of the rise of temperature at each point under various circumstances. Several of these curves are reproduced in the paper. It was noted that the ratio of the final rise of temperature to the number of watts is greater for the higher speeds. The following formula is given by Hawkins and Wallis for the rise of temperature of the field coils: $(a \times \text{watts}) \div [(1 + bv) \times \text{area}]$, where a and b are constants and v = peripheral speed in meters per second. Experiments at a light load give mean values of $a = 198.6$ and $b = 0.0263$, and at heavy load $a = 232.8$ and $b = 0.023$ for these constants.—London *Elec. Eng'ing*, Feb. 11, 1915.

Lamps and Lighting

Interference Photometer.—H. LUX.—An illustrated description of a new interference photometer and pyrometer of O. Lummer that permits one to make measurement of the surface brightness and temperature of very small and restless objects, and a comparison of adjoining portions of a lighted surface with respect to brightness.—*Zeit. f. Beleucht.*, January, 1915.

Carborundum Shunt for Series Incandescent Lamps.—H. LUX.—The use of incandescent lamps in series is objectionable because a shunt must be provided for each lamp so that in case of the extinction of one lamp the circuit is immediately and automatically closed again through the shunt. Since the introduction of the nitrogen-filled tungsten lamp the series system has again become of importance. The best current is 2 amp and for low candle-power lamps the voltage comes out as 10 to 15. Heins has found that the series connection of nitrogen-filled tungsten lamps offers no difficulty at all if each lamp is shunted by a carborundum resistor in solid or powdered form. When cold, the carborundum permits only a very small current to pass, but in the case of the extinction of a lamp more current will pass and heat the carborundum, which thereby becomes a better conductor. If the carborundum resistor has the proper dimensions, the voltage drop can be made exactly as desired. When a new lamp is inserted the current in the carborundum shunt decreases immediately to practically zero. The author has made a test of carborundum, using an ordinary piece of solid carborundum broken at random from a large lump and pressed between two strong lead plates. Fig. 1 shows the arrangement of the test and the results. K is the piece of carborundum between the lead plates. A is an ammeter and V a voltmeter. By means of the rheostat S the current A can be adjusted at will. The two curves give A the current and B the corresponding voltage across the carborundum piece. It will be seen that there is what the author calls a critical potential difference which when reached remains the same while the current is being increased over wide limits. This permits one to make suitable and reliable shunts for series

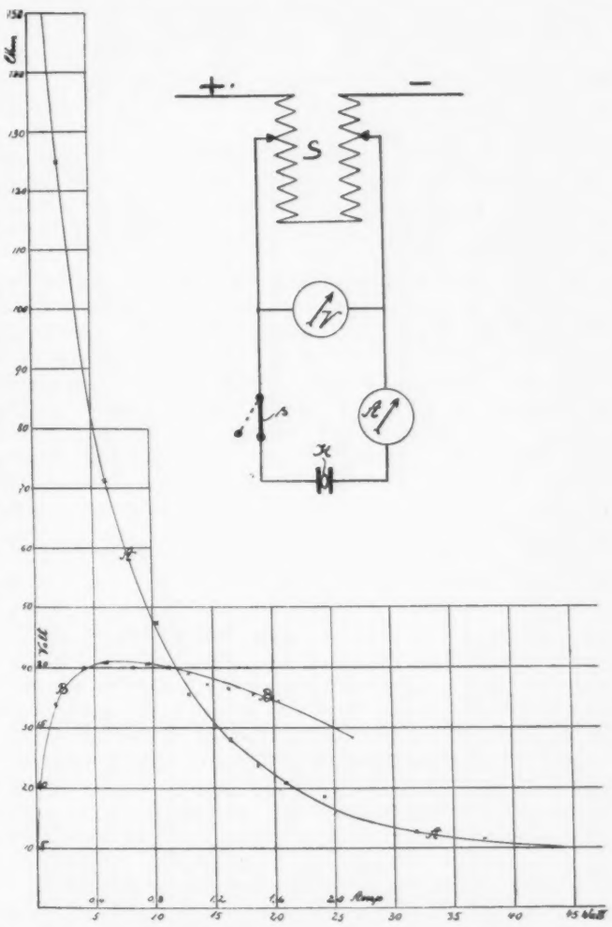


FIG. 1—ARRANGEMENT OF APPARATUS AND CHART

lamps if only the dimensions are so chosen that there is no obnoxious heating and especially no formation of sparks if powdered carborundum is used. With alternating current the carborundum crystals show the phenomenon of unidirectional conduction.—*Zeit. f. Beleucht.*, January, 1915.

Metallic-Filament Lamps.—A note on a recent British patent (No. 5456, 1914) of the British Thomson-Houston Company and the General Electric Company of this country for gas-filled metallic-filament lamps with short filaments, such as automobile lamps, with the filament of thinner section at the point where the cooling effect is greatest, that is, near the supports.—London *Elec. Eng'ing*, Feb. 11, 1915.

Generation, Transmission and Distribution

Possible Increase in the Charges for Electricity in London.—"The electricity supply stations in London have escaped the necessity of curtailing supply on account of lack of coal, although one was reduced a week ago to a stock sufficient for only one day's requirements and another to three days'; yet the enormous increase in the price is becoming more and more serious. Electricity works, which until a few weeks ago were paying

12s. 6d. ($3.12) per ton for coal suitable to their requirements, are now being asked prices up to 23s. ($5.75) for the same quality, and although this enormous increase is not general, yet prices are steadily advancing, and the shortage of supply is so serious that the works are compelled to buy, and coal merchants have matters their own way. The increased insurance and the longer time required for transit must necessarily raise the cost of sea-borne coal, but it is difficult to see why rail-borne coal should be affected except by the law of supply and demand. The shortage of trucks, owing to the congestion on the railways, is no doubt serious; but neither the actual cost of raising the coal nor its conveyance to London should be greatly increased, and it is obvious that there is a danger of undue profits being taken. . . . If prices continue to rise, the electricity supply authorities will have no option but to increase the price charged for electricity, and we have reason to believe that some have already in contemplation the necessity of doing this."—London *Elec. Eng'ing*, Feb. 11, 1915.

London and District Electricity Supply Bill.—The conclusion of the report by the "conference of the metropolitan boroughs owning electricity undertakings" in London. In this instalment the municipal aspects and alternatives of the schemes are discussed. The report, which is signed by H. H. Gordon as chairman of the sub-committee, concludes as follows: "We may regard the London County Council's proposed bill in the light of a prospectus issued to the people of London asking for their support. A strange reluctance is shown toward giving figures in support of the case. In view of the facts which have been given, this reluctance is intelligible. It does not serve, however, to strengthen the confidence felt in the suggestions. Revolutionary methods require consideration of an adequate kind before adoption, not after. The mere fact that London is to be endowed with yet another governing authority, which neither directly performs any service nor is directly responsible to the public, gives ample food for thought. With a world war in progress, in which nationally we are fighting for our existence, there can be neither time nor inclination to give the scheme that deliberate judgment its intrinsic importance demands. We must jealously guard our national resources. The influence of the 'silver bullet' is a paramount factor in determining the great struggle. Within the last few weeks the national exchequer has forbidden all fresh capital appeals for purposes not urgently important to our national existence. Can it be contended, by any stretch of imagination, that this is the time to embark on a hazardous scheme, involving an expenditure of £15,000,000 in the next few years and nearly £60,000,000 within the next generation? Under all the circumstances it is to be ardently hoped that, if the bill ever reaches the stage of examination by a committee of Parliament, the preamble will be found not proved."—London *Electrician*, Feb. 12, 1915.

Traction

Electrification of Italian Railroads.—Aldo Righi.—Italy depends for its coal on other countries, and especially on England. In view of the rapid rise of the cost of coal, the problem of the electrification of Italian railroads is quite important. The author endeavors to show that this would also permit considerable saving. He gives comparative costs of steam traction and electric traction on the Giovi line of the Italian State Railways. In the year 1909-10—that is, in the last year of steam traction—the total operating cost was 0.168 cent per ton-kilometer. In the year 1911-12—that is, the first year in which the electric system was exclusively used—the same cost was 0.130 cent. These figures include the total operating cost (maintenance, interest and amortization) of the electric power plant and transmission line. This means a reduction of cost of 22.5 per cent due to the electrification of the road. The power plant is operated by steam, and the cost of the energy is 2.466 cents per kw-hr. For large water-power plants in northern Italy the cost of the energy is much less, about 0.8 cent per kw-hr., so that the above figure for total operating cost per ton-kilometer for electric traction would become 0.092 cent—that is, 45 per cent less than for steam traction. If the fuel cost is deducted from the operating cost for steam traction and the electrical energy cost is deducted from the operating cost for electric traction, the operating cost per ton-kilometer becomes 0.116 cent and 0.086 cent respectively. That is, the electric operation is again less expensive. It is urged that as soon as possible a start be made with at least a portion of the 2300 km (1400 miles) of Italian main railways which are to be electrified.—*L'Elettrotecnica*, Sept. 26, 1914; abstracted in *Elek. Kraftbet. u. Bahnen*, Jan. 14, 1915.

Installations, Systems and Appliances

Overload Protection on Alternating-Current Circuits.—C. C. Garrard.—A continuation of his illustrated article on overload protection on alternating-current circuits by tripping devices. The author refers to the method of shunting the trip coil with a fuse. He then takes up the discussion of maximum alternating-current time-element relays constructed on the solenoid principle, and polyphase alternating-current relays.—London *Electrician*, Feb. 12, 1915.

Electric Steering Gear.—A note on a recent British patent (No. 73, 1914) of W. H. Scott. This system of applying electric power to supplement hand power is applicable to steering gear, lock-gate and sluice opening, and a number of other purposes. A coupling allowing of a certain amount of slack is provided between the controlling hand wheel and the work, and contacts are provided, so that one set are closed when the drive is in one direction and another set when the drive is in the other direction. These contacts, acting through suitable relays, etc., start the motor in the direction to assist the motion, and the motor runs as long as the movement is followed by the hand wheel. As soon as the motor begins to overrun the contact is opened and the motor stops. The drive is through a centrifugal or other clutch, which leaves the motor disconnected when it does not start up owing to failure of current, so that the hand gear can be used alone.—London *Elec. Eng'ing*, Feb. 4, 1915.

Starting Resistance for Motors.—B. W. Jones.—An article giving simple formulas for calculation of the resistance of starting rheostats for shunt, induction and series motors.—*Gen. Elec. Review*, February, 1915.

Electrophysics and Magnetism

Electric Conduction in Crystals of Metallic Selenium.—F. C. Brown.—An abstract of an American Physical Society paper. Crystals of metallic selenium are peculiarly adapted for a test of the electron theory of conduction because of the varied interrelated optical, mechanical and electrical properties. A large number of fundamental experiments have been carried out, which involve large changes in the electrical conductivity. It is postulated that the nature of the conductivity is the same regardless of the physical conditions that have influenced it. Since the specific conductivity may vary several hundred per cent by any one of several agencies, it is not conceivable that a variation in the free path or the velocity would sufficiently account for any of the changes. Rather a change in the number of conducting electrons must be expected to account for the varying

conductivity. The usual free electron theory does not explain all the facts. The author proposes a modified form of the electron theory that seems to satisfy all the fundamental experiments thus far recorded. The view supposes that a large portion of the conducting electrons in the crystal are ordinarily fixed in the crystal structure in varying degrees of stability. When an electric field is established across the crystal a certain average number of these fixed electrons are rendered unstable or free. The divergence from the usually accepted notion is that they remain free only for a relatively short interval of time. Thus in these crystals the current increases with voltage more rapidly than required by Ohm's law. The effect of the increase of pressure is to lessen the degree of the stability so that the mean interval before the recombination of the electrons is increased. Obviously this seems to explain satisfactorily the increased light sensitiveness with increased pressure and the exact proportionality observed, and also the limitation of this increase to the region of the crystal under pressure. The transmitted light action is probably a mechanical disturbance propagated in the crystal, and it enters into this theory only as the disturbance keeps electrons out of their fixed positions. —*Physical Review*, January, 1915.

Magnetic Induction of Heusler Alloys at High Frequencies.—H. FASSBENDER.—The author first gives an account of an experimental investigation of Heusler alloys at high frequencies. Tests were made at frequencies between 47,000 and 120,000 cycles per second and at maximum field intensity of 21, 32 and 43 gausses. The question is discussed whether Heusler alloys will be practically useful for high-frequency engineering. The author thinks that too much should not be hoped from this material. Its essential advantage is the high specific resistance, which is particularly important at high frequencies. But the disadvantage is the difficulty of mechanical handling of the material as it is impossible to roll thin plates of these alloys. In the second part is given the theory of magnetic skin effect. —*Archiv f. Elektrotechnik*, Vol. 2, 1914, page 475; abstracted in *Elek. Zeit.*, Jan. 7, 1915.

Electrochemistry and Batteries

Fixation of Atmospheric Nitrogen.—E. KILBURN SCOTT.—After a brief description of the Bireland-Eyde, the Schönherr-Hessberger and the Pauling furnaces, a new furnace devised by the author and operated by three-phase currents is described. In general principle the furnace follows the Pauling type, except that there are three electrodes instead of two.—London *Elec. Review*, Feb. 5, 1915.

Units, Measurements and Instruments

Metallic Roentgen-Ray Tube.—L. ZEHNDER.—Roentgen-ray tubes of glass permit the rays to be radiated in all directions so that they have to be screened off by means of metallic screens everywhere except at the exact point where they are intended to act. The present author overcomes this difficulty by making the tube itself of metal and insulating the cathode from the metallic walls and the anticathode and anode by a strong high-tension insulator. One small "window" is provided which lets a bundle of Roentgen rays pass out. Larger tubes may have two or more windows. The construction is shown in Fig. 2. Upon the metallic casing *M* (of brass) a high-tension insulator *J* (of porcelain) is placed, the contact surface being closed air-tight by a rubber ring or with sealing wax. The interior of the high-tension insulator *J* contains a strong double copper tube *R*, its upper end being connected air-tight with the rim of the high-tension insulator. This copper tube carries at its lower end the cathode *K*, which is embedded in a hollow space especially provided for this purpose in the insulator. It is so constructed that cathode rays can pass out only from the concave spherical cathode surface. All other portions of the cathode surface are in tight contact with the porcelain insulator. The whole metallic casing *M* serves as an anode and may be earthed. In the center of the bottom of the metallic casing the anticathode *A* of copper is provided. The effective anticathode surface is plated with a layer of a metal of high atomic weight. *F* is the "window" of glass or aluminum, which is also closed air-tight. All tight fittings are protected by protective walls against the effect of cathode rays. Opposite to the window *F* and separated by a screen *S*, there is an auxiliary vessel *N* which is connected air-tight to casing *M*. The vessel *N* contains carbon particles *C*, which when heated or cooled give off air or absorb it. This vessel *N* is electrically heated. The cathode *K* is made of a refractory material, like magnesia, and the hollow spherical surface is covered with tungsten by the Schoop

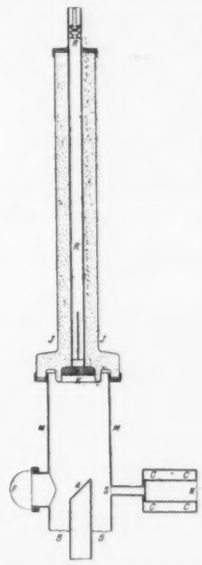


FIG. 2—METALLIC ROENTGEN-RAY TUBE

spray process. "One-half of the circumference is connected with one tube and the other half with the other tube" of the double copper tube *R* which carries the cathode, so that by means of an insulated battery the cathode may be heated by an electric current. Even at the highest vacuum it is, therefore, possible, as in the Coolidge tube, to produce electrons and generate Roentgen rays of any degree of hardness with the highest intensity. The hollow cathode is exactly spherical so that without further artificial means all cathode rays can be sharply focused. The advantages of this Roentgen-ray tube, which is not patented, are discussed.—*Elek. Zeit.*, Feb. 4, 1915.

Practical Harmonic Analysis.—A. RUSSELL.—A brief abstract of a British Physical Society paper. The author considers the problem of the best way of determining the Fourier constants in the series equation which represents it, making the assumption that the graph of a periodic function is given. Various methods for this purpose are critically discussed. The author concludes by pointing out that in the great majority of cases much the best method of procedure when determining the constants is to evaluate Fourier's integrals by the methods of mechanical quadrature given in books on the calculus of finite differences. In particular he has found that Weddle's rule is admirably adapted for the practical computation of the Fourier integrals. By means of this rule each constant is determined sepa-

rately to a high order of accuracy. Numerical examples are given to illustrate this. The series formulas used by Thompson can be usefully employed either for verifying the values found by mechanical quadrature or for indicating when the higher harmonics cannot be neglected.—London *Electrician*, Feb. 12, 1915.

Wheatstone Bridge.—R. EDLER.—A mathematical article on the theory of that modification of the Wheatstone bridge in which the length of the slide wire can be extended to twice or three times its ordinary length. The arrangement is shown in Fig. 3, where x is the resistance to be determined, R the comparison resistance, G a galvanometer, and the slide wire is inserted between the terminals K' and K'' as shown. The slide wire consists of three parts of identical lengths. The first part is indicated in the illustration as M_1 between the terminals and K' and K_1, the second part is the slide wire between K_1 and K_2, which is divided by the sliding contact C into two portions a and b. The third part is

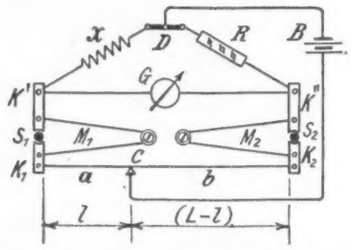


FIG. 3—WIRING ARRANGEMENT FOR WHEATSTONE BRIDGE

indicated by M_2 and is inserted between the terminals K'' and K_2. By inserting the copper plug S_1 the portion M_1 can be short-circuited. By inserting plug S_2 the portion M_2 is short-circuited. a and b have together the length L, also M_1 and M_2 have each the same length L. In order to facilitate the use of the instrument, a scale is provided which gives for each point of the wire between K_1 and K_2 directly the reading $A = a \div b$ or $l \div (L - l)$. This ratio is valid if the plugs S_1 and S_2 are inserted. If S_1 is removed and S_2 is inserted, the reading is $1 + 2A$. If S_1 is inserted and S_2 is removed the reading is $A \div (2 + A)$. If both S_1 and S_2 are removed the reading is $(1 + 2A) \div (2 + A)$. A table of these different values is given.—*Elek. u. Masch.* (Vienna), Jan. 17, 1915.

Series Transformer.—M. ROSENBAUM.—A mathematical paper on the theory of series transformers, taking into consideration the leakage of the primary and secondary circuits and discussing the effect of this leakage and its influence on the accuracy of the transformer when connected to instruments.—London *Electrician*, Feb. 12, 1915.

Telegraphy, Telephony and Signals

Future Progress of Cable Telegraphy.—H. W. MALCOLM.—In a continuation of his very long mathematical serial the author takes up the discussion of the duplexed cable and reaches the conclusion that the shape of the arrival curve in duplex working may be slightly better or worse, depending upon the connections, than in simplex working, but its height is invariably reduced—in the most favorable case to one-half the simplex curve. Provided that the cable is perfectly balanced at the receiving end, the received signals are independent of the impedance between the apex of the bridge and earth.—London *Electrician*, Feb. 5, 1915.

Wireless Telegraphy.—L. W. AUSTIN.—The testing of the recently erected high-power United States naval radiotelegraphic station at Arlington, Va., has given another opportunity for carrying out experiments on the relation between the currents in sending and receiving antennas at various distances, and at the same time for investigating the relative advantages of transmission by means of damped and continuous oscillations. At present the observations on the transmission of different wave-lengths over great distances are too meager in number to settle the question of the relation between the attenuation of the signals and the wave-length. It is certain, however, that the attenuation even over sea water is very much decreased as the wave-length is increased. The comparisons made of the efficiency of arc and spark transmission have indicated that for distances of the order of 3700 km or more continuous oscillations are on an average superior. The evidence is not complete enough to prove that this superiority always exists. It is apparently connected in some way with the reinforcement of the signals from the upper layers of the atmosphere, and is subject to the vagaries of this portion of the received energy. The indications seem to be that the superiority of the continuous oscillations is greater in winter than in summer.—*Bulletin*, Bureau of Standards, Vol. II, No. 1 (Nov. 15, 1914).

Miscellaneous

Russia.—Classified tables of Russian importations of electrical goods from 1906 to 1913.—London *Elec. Review*, Feb. 12, 1915.

Book Reviews

ELECTRICITY IN COAL MINING. By David R. Shearer. New York: McGraw-Hill Book Company, Inc. 84 pages, 28 illus. Price, $1.50.

This is a general treatise on the different uses of electricity in connection with the operation of a coal mine and the advantages to be gained by such uses. The fundamental laws governing both direct-current and alternating-current circuits are given. Considerable space is devoted to pointing out the necessity of careful selection of the electrical apparatus to be installed, and of efficient operation. There are a number of excellent illustrations showing power-plant installations, coal-cutting and coal-hauling machinery, and several wiring diagrams for bell circuits and motor circuits. The different types of prime movers, generators, motors and pumps are discussed to some extent. The text includes an appendix of four pages, which contains formulas for direct-current and alternating-current calculations, a wire table and a table of equivalents.

EXAMINATION OF LUBRICATING OILS. By Prof. Thomas B. Stillman. Easton, Pa.: The Chemical Publishing Company. 126 pages, 33 illus. Price, $1.25.

This book deals with the examination of lubricating oils from the standpoint of the chemist who has at his command all the laboratory facilities and apparatus necessary for accurate work. It is not a handbook of instruction for the use of the average operating engineer who wishes to know how to conduct simple tests of lubricants for bearings and steam cylinders. It describes methods of testing for specific gravity, viscosity, flash point, firing point, acidity, gumming, sulphur and water. Moreover, it gives directions for making cold tests, separating mineral oil from vegetable or animal oil, determining the coefficient of friction of a lubricant, and analyzing deposits found in steam cylinders. Specifications for various kinds of lubricating oils, as issued by different railroad companies and by the United States Navy Department, form an interesting and instructive feature. A few pages are devoted to a brief consideration of graphite and greases, and the United States government specifications for fuel oil are included.

POWER AND OPERATING SECTION

Clean Oil Ducts Necessary for Good Lubrication

When setting up a new machine for the first time or when reassembling a machine which has been repaired it is advisable to blow out the lubricating system with compressed air to remove particles of waste or dirt which may have collected therein. If an oil-circulating system is employed, the machine should then be run for three or four weeks, after which the old oil should be replaced by a new supply. If the oil which is removed is badly contaminated with impurities, as many as possible should be separated in a settling basin and the rest removed by heating the oil and forcing it through filters. The clarified oil may then be employed for make-up purposes.

Installing a 2000-kw Substation in Fifteen Days

To house 2000 kw in motor-generator equipment for the supply of direct-current energy to a down-town district pending the erection of a permanent substation on the same site, employees of the Edison Electric Illuminating Company of Detroit on Jan. 12 commenced construction of a temporary substation designed to be ready to operate before the end of the same month. Six days later, or on Jan. 18, the photograph reproduced herewith was taken. As will be noted, this shows the building structure practically completed and one 1000-kw motor-generator set in position on its foundation, although a week before the ground of this vacant lot had not been disturbed.

TEMPORARY 2000-KW SUBSTATION SIX DAYS AFTER BREAKING GROUND

This temporary substation is to be dismantled when the permanent station is ready in June. It was therefore determined to make the installation of the most practical character possible. The steel frame of the hastily erected structure is sheathed with corrugated metal. From the blank metal walls window spaces were rapidly cut out with the aid of an oxy-acetylene flame, and second-hand window sashes were fastened into place to admit light to the operating room. The machines, weighing 50 tons each, rest on brick foundations. Tile conduits convey the leads to the units and switchboard. The motor-generator sets were skidded to their present position from a building half a block distant. In order to preserve service it was necessary to keep running at all times at least two of the three 1000-kw sets in the original installation. This condition required that only one machine should be moved at a time and that both sets not actually in transit should be kept operating continuously. The third unit of the original set of three was transferred to another substation of the company. With the machines the switchboard equipment was also moved. Such special parts as were needed were made in the shop and delivered to the job ready to be put into place on the new installation. The new temporary substation transforms 4400-volt energy into direct current for the neighboring direct-current customers of the company.

Thawing Water Pipes with Electricity

Frozen water pipes may be thawed by electricity (1) by sending a large current (50 amp to 150 amp) through the pipe affected, (2) by applying some electrically heated device as a flatiron to the outside of the pipe where frozen, if the latter point is accessible, or (3) by inserting an electrode into the pipe (which forms a miniature water rheostat) and electrolyzing the water, thus melting the ice plug as the electrode is pushed into the pipe. The method last described can be employed only where the frozen pipe can be reached directly, but it has the advantage of requiring no special equipment and no heavy current demand, although several hours are needed to melt out an ordinary frozen pipe.

Where more than one service is to be thawed the general practice is to load one or two 5-kw or 10-kw transformers on a wagon or other vehicle, drive to the job, and after making connection with some primary line near the customer's premises connect one side of the secondary to a nearby fire plug and the other to the frozen pipe in the customer's basement. If possible, it is preferable to disconnect the house piping from the service line in order that return currents may not find their way back through the house piping and cause damage in some unexpected place.

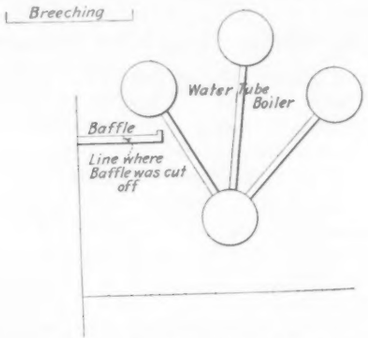
ELECTRICAL PIPE-THAWING EQUIPMENT LOADED ON WAGON

Various equipments of switches, ammeters, fuses, circuit-breakers, impedance coils, etc., have been used on pipe-thawing equipments assembled hastily from apparatus on hand, but, on the other hand, good "first aid" service has also been performed with equipment consisting only of a transformer protected by primary fuses. To thaw 100 ft. of average 0.75-in. pipe re-

quires about 100 amp at 100 volts. The time required may vary from ten minutes to half an hour, and the energy consumed will amount to 2 kw-hr. to 10 kw-hr. Special pipe-thawing transformers are, of course, available from manufacturers of electrical apparatus.

Checking Up Draft Conditions Shows Baffle to Be Too Long

While charting the draft pressures in the various parts of a boiler setting in the plant of the Springfield (Ohio) Light, Heat & Power Company, it was discovered that at one place near the rear wall the draft pressure dropped from 0.7 in. to 0.5 in. in a very short distance. An examination instituted to disclose the cause for this unusual condition showed that a baffle, 28 in. long, projected from the rear wall at that point. Approximately half of that baffle was then removed, and a subsequent test showed that the draft pressure at the breeching above the baffle had been increased slightly and that the stack temperature had been reduced from 625 deg. Fahr. to 575 deg. Fahr. Hence, by the simple process of examining into the relative draft pressures existing within the boiler setting a condition which was wasting coal was discovered and was remedied.



PART OF BAFFLE REMOVED TO BETTER DRAFT CONDITIONS

Automatic Device for Timing Relay and Fuse Operation

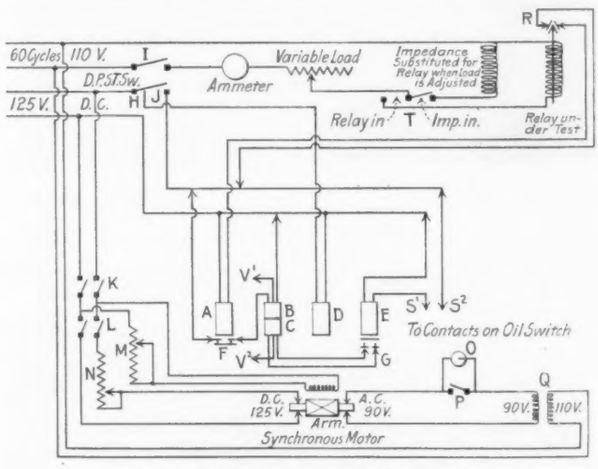
If relays in sub-feeder circuits are not regulated to operate their switches before the main-feeder relay trips its switch, disturbance in one circuit may cause the main switch to de-energize all of the sub-feeders before the particular sub-relay can act. This would be very objectionable; therefore the time lag in the operation of each relay and the switch it controls should be known quite accurately. A stop watch is hardly satisfactory for this determination, especially if the time is measured between the application of a tripping current and the lighting of the oil-switch pilot lamp, as the filament requires appreciable time to become incandescent. The accuracy of a stop-watch test also depends on the person conducting it.

To overcome the objections to stop-watch measurements and provide means of determining the time lag of relays and oil switches to within 1 or 2 per cent the United Electric Light & Power Company, New York City, is employing a portable automatic device which can also be used to measure the time element involved in various kinds of tests, such as the rupturing of fuses at different current values, etc. The apparatus consists of a mechanism for drawing a strip of paper at a definite rate under two pen points which are moved by electrical means when (1) the relay-actuating current is applied, when (2) the relay contact closes, and when (3) the oil switch opens. The interval occurring between each of these operations is computed by measuring the distance between the jogs in the curve and multiplying the values by a constant, depending on the frequency applied to the operating motor, the synchronous speed thereof and the gear ratio.

The paper strip employed is perforated along both edges the same as recording-instrument tapes, so as to mesh with propelling wheels driven through gearing and a clutch by a small two-pole synchronous motor. The motor is provided with a commutator so it can be started as a direct-current motor while synchronizing. To compute the time required for the paper to move a distance equal to the circumference of the propelling wheels the frequency applied to the motor is multiplied by the gear ratio. Reducing this value to the time required for the tape to move 1 in., it is simple to measure the distance between jogs with a steel rule and multiply the reading in inches on a slide rule by the constant to obtain the time interval. It is unnecessary to make these computations every time a test is conducted as a curve has been plotted from which the constant for any frequency can be read directly.

The mechanism and switches operating the pens and moving the tape are ingeniously arranged and connected. Under the table over which the paper travels are four solenoids arranged side by side. One of these has two windings and two plungers, one on each end, for operating the pens. The windings are separately controlled by contactors operated by solenoids on each side of the pen actuator. At the end of the table toward which the paper travels are the propelling wheels and clutch connecting them with the driving motor. The clutch is closed by a solenoid directly beneath the wheels.

Besides the equipment for synchronizing and operating the tape-propelling motor and resistances for limiting the current through the relays or fuses being tested there are several switches. One of these, which is of the single-blade, double-throw type, is for replacing the apparatus being tested by an impedance while adjusting the current-limiting resistance. Another switch is provided with two single-throw blades and an auxiliary lip for starting the paper tape first and closing the relay circuit and solenoid circuits finally and simultaneously. With the apparatus connected to a relay and its oil switch for testing, closing the tape-starting switch moves the pen slightly across the paper, the tape meanwhile traveling uniformly. When the relay contact closes it causes one of the contactors to open the solenoid circuit, thereby making a



APPARATUS FOR TIMING RELAYS

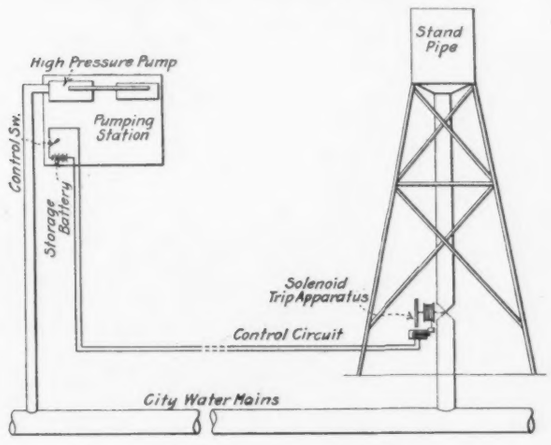
jog in the line traced on the paper. When the oil switch trips the pilot-lamp switch energizes a contactor and moves the other pen transverse to the line it was tracing.

The accompanying drawing shows the connections employed with the device. Switches *K* and *L* control the direct-current side of the synchronous motor. *M* and *N*, which are variable resistances in the field and armature circuits, are used when synchronizing and are of such value that the motor may be operated on a 125-volt or 250-volt direct-current circuit. Switch *K* in the field circuit is so connected that the field of the motor cannot be cut off without disconnecting the armature circuit. *O* is a small lamp used for synchronizing and *P* is the alternating-current motor switch; *Q* is a small transformer used for the purpose of reducing the alternating-current voltage about 20 per cent.

A, *B*, *C*, *D* and *E* are the solenoids described above; *D* operates the clutch which drives the paper under the pens V^1 and V^2, which are held in normal position by springs; *B* and *C* are the pen-actuating magnets. Coil *B* is connected to the direct-current control circuit through switch *F*, which is normally closed. When contacts *R* are closed by the action of the relay, coil *A* is energized, causing switch *F* to open. Coil *B* is thus de-energized and the pen shifts slightly because of its control spring. S^1 and S^2 are lines leading to contacts on the primary switch controlled by the relay. When the contacts close, coil *E* is energized, thus closing the contacts in switch *G* and actuating the pen V^3 through its coil *C*. Contact *H* on the main switch actuates the clutch magnet and simultaneously energizes the recording circuits.

Electrical Control of Pressure on City Water System

Under normal conditions the city water system at Salem, Ohio, operates at about 85 lb. per sq. in. pressure, but for fire service it is necessary to increase the working pressure to 125 lb. or perhaps to 140 lb. per sq. in. To increase the pressure on the system the first step, of course, is to take the standpipe off the system, because with the top of the standpipe open it would be impossible to increase the pressure beyond that afforded



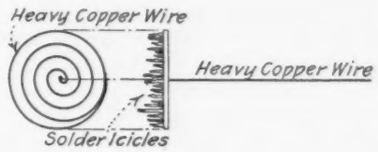
VALVE CONTROL CIRCUIT

by a static head equal to the height of the standpipe. After the standpipe has been taken from the line the pumps, forcing water directly into the mains, quickly bring the working pressure up to that desired.

At Salem, however, the standpipe is placed on a hill about a mile from town, and the pumping station is in the city. To enable the engineer at the station to cut the standpipe off the line quickly, an electrical circuit was strung from the station to the standpipe and there connected to a solenoid-controlled tripping mechanism. When the circuit is closed through a switch in the pumping station, energy from eight cells of storage battery actuates this solenoid and releases a weight which, falling by gravity, closes a gate valve in the standpipe line.

How to Make a Ground Plate from Scrap Material

A short length of heavy copper wire coiled to form a flat spiral, then dipped into molten solder and slowly withdrawn so that solder "icicles" form on the bottom of the spiral, will serve as an inexpensive ground plate.



HOME-MADE GROUND PLATE

Addition of the solder in this way gives the spiral considerably more surface than the bare wire would afford.

While engaged in building a 14-mile transmission line the construction crew of the Ohio Light & Power Company at Tiffin, Ohio, used this method of making earth terminals with success. Before dipping the spiral of wire into the molten solder it was necessary, of course, to clean the copper and give it an acid bath so that the solder would adhere to it. With six such ground plates as these, connected to an overhead ground wire and buried in the beds of six small streams flowing under the line at different places, it is thought that the 14-mile line is well protected.

Wire and Starting-Fuse Sizes for Induction-Motor Service

At the meeting of the Western Association of Electrical Inspectors at Minneapolis the suggestion was made that the determination of starting fuses and wire sizes for induction motors be expressed as a ratio of the full-load running current of the motors, rather than in terms of the motor horse-power rating. Starting-fuse sizes were recommended as follows: Up to 30 amp, 250 per cent of full-load current; 31 to 100 amp, 200 per cent of full-load current; 101 amp and upward, 150 per cent of full-load current.

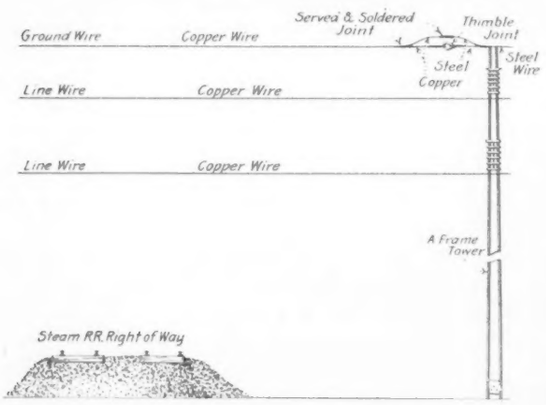
In describing the tests made to determine safe values for fuse and wire sizes, Mr. F. A. Barron, Schenectady, N. Y., said that the motors under observation were belted to a generator with a water-box load. As soon as the motor and generator had started under way the generator field resistance was cut out, imposing a very high starting current on the motor. This period of excessive acceleration varied from fifteen seconds to thirty seconds. After a rest of thirty seconds the motor was again started in the same way and the test repeated altogether twenty-five times. The fuses that held under these conditions were considered to be a safe standard for this service.

It was also pointed out that in the case of the larger motors the fuse and wire capacity can be only 50 per cent above the motor ratings on account of the greater heat-storage capacity of the larger fuses, which enables them to stand severe overload for periods up to thirty seconds without blowing.

Solving the Difficulty of Galvanic Action Between Steel and Copper Spans

Over steam-railroad rights-of-way it is generally considered best practice to use copper wire in transmission-line construction, because the sulphur fumes in the smoke attack steel and soon render it useless. On the other hand, it is also common practice to use steel ground wires to protect transmission circuits. Obviously, the idea of using a steel ground wire at all places except in spans over railroads, and inserting at such spans short stretches of copper wire, presents the most economical solution of the ground-wire problem. Such was the belief of the builders of the transmission line of the Ohio Light & Power Company between the cities of Fostoria and Tiffin, Ohio.

The combined steel and copper ground-wire plan has only one bad feature, namely, the joints between steel and copper are known to be unreliable because of galvanic action produced by the soldering together of two unlike metals. To meet this difficulty the joint shown in the sketch herewith was worked out. The main-line wire connections at the junctions of the copper and the steel were made simple thimble joints. With well-made "serve-ups" these thimble joints could be made as strong



METHOD OF JOINING COPPER AND STEEL GROUND WIRE

as or stronger than the line wire. To give a more perfect electrical connection than was afforded by the thimble joint a jumper of one-half copper and one-half steel was made with a served and soldered joint in the middle, and this jumper was served and soldered around the thimble joint with copper to copper and steel to steel. In this way there is provided both an excellent electrical conductor and a joint of high mechanical strength, eliminating as far as possible both the dangers of broken ground wires caused by local galvanic action and the loss incident to more or less frequent renewals of steel-wire railroad spans.

Remotely Controlled Mock Distribution System

A number of central-station companies have provided their system operators or load dispatchers with mock distribution layouts to indicate the position of switches, but these are usually operated by hand. In the Gold Street generating station of the Edison Electric Illuminating Company of Brooklyn, however, is a dummy high-tension distributing system in which the positions of switches are indicated by small pilot lamps controlled from a cabinet installed near the system operator's desk and telephone switchboard. Red and green lamps indicate whether the bus-tie switches are in or out respectively, while white lamps indicate machine and feeder switches.

Only the feeder disconnecting switches are operated by hand, red tags being attached thereto when these must be left open for repair work and white tags being employed when the system operator desires to keep them temporarily out of service. The conductors are colored according to the stations from which they radiate. For instance, all substation-tie feeders are enameled green,

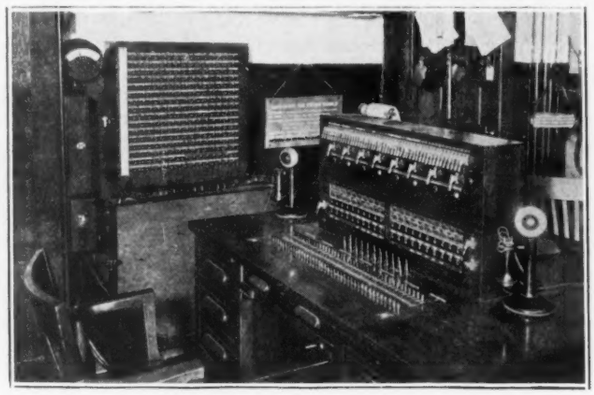


FIG. 1—SYSTEM OPERATOR'S DESK AND CONTROL BOARD

while those from the two generating stations are enameled silver and gold respectively. Thus it is possible to determine quickly what feeders are supplying energy to a certain district.

All generating stations and substations are referred to by numbers. These are marked on the feeders to show the terminals of the conductors. Following the figures indicating the terminals of the feeder is the number for the particular feeder. The advantages of

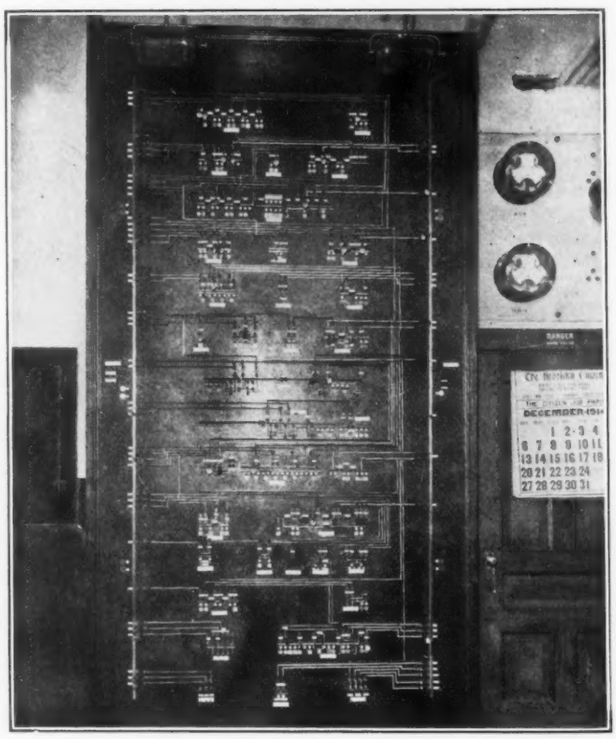


FIG. 2—REMOTE-CONTROL MINIATURE HIGH-TENSION DISTRIBUTION LAYOUT

this dummy layout are that the system operator is able to indicate the position of the switches thereon without moving from his chair, and besides is able to tell at a glance what generators are operating, what feeders are energized, and what feeders are out of service because undergoing repairs.

COMMERCIAL SECTION

To the Employee in a Rut

Following is the pointed advice posted on the bulletin board of a large central-station organization in which employees are encouraged to be on their mettle at all times and to beware the comfortable feeling of security which too often comes to the man doing routine duty:

"WHICH?

"The bookkeeper who feels his job is a certainty, the clerk who regards his company as a perpetual meal ticket, the local manager who gets gout in the head, is sure to sink into dullness; and then something happens.

"A man is always either bigger or smaller than his job. If he is bigger, he is on the way up. If he is smaller, he is on the way out."

Advocating More Light to Minimize Burglaries

To stimulate the sale of electric lamps, the Edison Lamp Works of the General Electric Company are laying considerable emphasis on the number of night burglaries and robberies which are being committed. In the January bulletin issued by this branch of the company it pointed out that dealers and central-station companies can do likewise to increase their business. It was recommended that local newspapers be watched for

CAUTION

To Householders:

About this time of the year *second-story* thieves begin their operations. It is for this reason that I would request you not to leave the upper rooms of your house unprotected between the hours of 5.30 p.m. and 8 p.m. See that the windows are fastened. It is also advisable to leave the rooms lighted. Thieves do not like to work in the light.

This department will use every means to prevent such robberies and requests your co-operation in this matter.

JOHN DRABELL,
Chief of Police.

CARD ADVOCATING NIGHT LAMPS

accounts of burglaries and that newspaper advertisements based thereon be immediately published to arouse the public to the need for more light. Special stress should be laid on canvassing the territory in which the burglary occurred. Favorable results may be obtained by bringing the urgency of additional street illumination to the attention of the police department. By preparing cards similar to the one shown herewith and submitting them to the police authorities in the proper manner, the police can be induced to distribute them. Pictorial advertisements can also be prepared to suggest the feeling of safety which accompanies the use of electric lamps.

Distinctive Textile Power Service Advertising

The Edison Gas & Electric Light Company, of New Bedford, Mass., has been running an interesting series of textile power advertisements in the local Sunday papers during the last year, bringing out many points of importance in relation to the availability of central-station energy for industrial service. The series began with an announcement to the effect that local manufacturers using 1000 hp or more would find it advantageous to inquire into the 1-cent-per-kw-hr. rate offered by the company as a result of the remodeling of its generating station. Later it was stated that 352 textile mills in the United States purchase electricity, and that these mills take about 150,000 hp from 113 central stations. It was pointed out that the minimum rate in New Bedford, which is supplied from a steam-driven central station, is

Cost Of Running
1000 H. P. Per Year

STEAM.

Operating expense	$15,000.00
Interest and depreciation	8,000.00
Total cost	$23,000.00
COST PER HORSE POWER, YEAR	$23.00

ELECTRICITY.

Current consumption	2,047,024 K. W. H.
Cost of current at 1 cent per K. W. H.	$20,470.24
COST PER HORSE POWER, YEAR	$20.47

Can You Afford to Install
Your Own Power Plant?

NEW BEDFORD GAS AND EDISON LIGHT CO.

FIG. 1—STEAM VERSUS ELECTRICITY

practically as low as that charged by the Southern Power Company.

The company's "copy" also brought out the value of individual motors in stopping speed variations due to faulty transmission and varying lengths of shafting,

WOULD YOU DO THIS?

A prominent silk manufacturer of this state, after investigating additional power installation for his mills, found that the lowest cost per K. W. H. the manufacturer of electrical equipment would guarantee was 1.25 cents. He concluded to buy current from the local central station at a price of 1.30 cents, saying it was worth the difference in price to have someone else do the worrying of keeping his power plant running.

He Is a Successful Manufacturer

NEW BEDFORD GAS AND EDISON LIGHT CO.

FIG. 2—CENTRAL STATION VERSUS PRIVATE PLANT

touching upon the usefulness of the individual motor drive in relation to mill enlargements or additions to machinery. Stress was repeatedly laid upon the fact that the central-station organization specializes in economical power production, leaving its customers to specialize in their own industrial concerns.

Do You Believe

That large scale production means economy.
That specialization means efficiency.

Then Just Remember

That we are large scale producers of power.
That we are specialists in power generation.

Get Our Rates

NEW BEDFORD GAS & EDISON LIGHT CO.

FIG. 3—ECONOMY AND EFFICIENCY

The company pointed out that a prominent silk manufacturer of Massachusetts made a wise choice in deciding to buy electricity from a central station at 1.30 cents per kw-hr., although manufacturers of electrical equipment figured that he might be able to produce it for 1.25 cents, the textile man figuring that it was

worth the difference in price to have someone else do the worrying about continuity of service.

One telling piece of publicity urged the mill owner not to get excited in case of a breakdown of his engine, but to call up the Edison company, which stands ready to furnish energy in any quantity for a day, week or year, and at once without delay. Three specimen advertisements are shown herewith.

Increase in Electric-Service Businesses at Louisville

Since the consolidation of the competing electric companies at Louisville, Ky., about one year and one-half ago, the number of consumers in that city has increased by 6015, or 35 per cent. These gains were the result of vigorous sales and advertising effort in which the wiring of already built houses and a campaign for operating motors were features. Despite the fact that four electric companies had previously operated in Louisville, it was found that a large field existed for the development of new business.

A fact often lost sight of in the electric-service industry is that a large investment on the part of the public is necessary in order to receive and apply the service. At Louisville, for example, the records at the city hall show that wiring permits covering work valued at a total of $2,281,477 have been issued during the five years ended Sept. 1, 1914. Last year's records indicated a large increase in the number of permits but a slight falling off in the value of the total expenditure, showing that there were fewer large jobs and more small ones, such as the wiring of cottages, which the Louisville Gas & Electric Company, in co-operation with the wiring contractors, made a special objective.

TABLE SHOWING INCREASE IN PERMITS ISSUED

Year	Number of Permits	Value of Work
1910	2,175	$264,279
1911	2,570	447,819
1912	3,469	526,368
1913	4,726	537,920
1914	6,042	505,091

All of the available statistics show that the community is being served to a far wider extent by one company than it was formerly served by several companies. It has been reported that residence customers are also served at a lower rate than they paid formerly.

Beginning Early to Educate the Public

Progressive central-station companies have come to know the advantage of keeping their names before the public in a favorable light. Recently the Springfield (Ohio) Light, Heat & Power Company has expanded the term "public" to include the city's school children, and Mr. J. E. North, the company's contract agent, and Mr. Hugh Hagan, its attorney, have addressed high-school classes in physics on subjects of electrical interest.

"Edison Day" was made the occasion of one of these talks, and on that day the speakers dwelt upon the life and achievements of America's great electrical inventor and presented the class with a reproduction of Mr. Edison's first lamp. Each member of the class also received from the company a picture of Mr. Edison himself. In order that the talks should not be received by the youthful audience as mere lectures, they were interspersed with humorous tales bearing on the work of the inventor. In one of these stories the inventor was depicted as using a red hair from the beard of an associate for the filament for one of his experimental lamps. In this experiment, as the story goes, he had the advantage of a flying start, for even before energy was applied the lamp filament gave off a dull red glow.

Electric Flashing Effect on Signboard

On a 10-ft. by 30-ft. signboard used for advertising coal in Toledo, Ohio, an electrically operated flashing arrangement has been worked out to simulate a flaming grate fire. The painted scene on the board shows the interior of a cozy living room and a man with his book and evening paper facing the cheery coal fire. The "fire" itself is painted in tints and colors on a pane of glass, which forms the face of the fireplace, and lifelike leaping of the flames is produced by flashing four 40-watt lamps behind the painted glass. The billboard is well illuminated by four 100-watt lamps in hooded reflectors. The May Sign Company, of 1001 Adams Street, Toledo, Ohio, maker of this display, makes it a practice never to use lamps smaller than 100 watts rating for billboard illumination.

FLASHING SIGN IN BILLBOARD DISPLAY

New Lighting Standards for a Portland Boulevard

A constant-current series-lighting system has recently been completed on Terwilliger Boulevard in Portland, Ore., using the lighting standards shown in the accompanying illustration. About 3½ miles of the boulevard is lighted in this way, ninety-one standards being used and spaced 150 ft. apart.

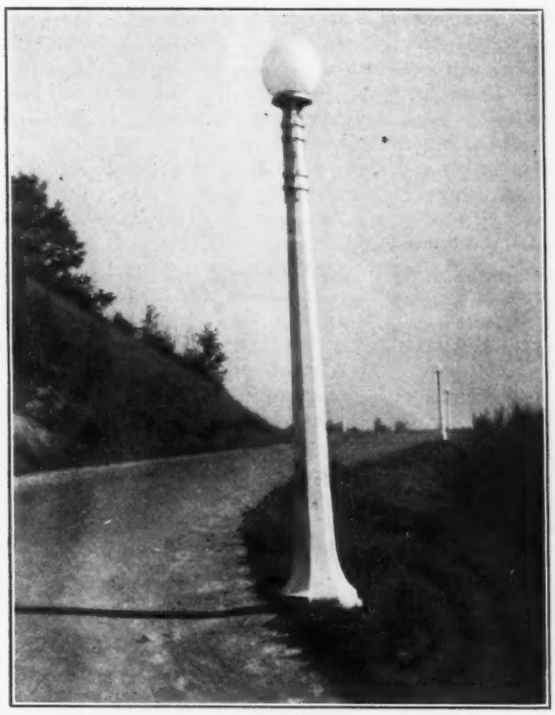
The park board decided upon building concrete comfort stations along the boulevard, and it was found possible to set aside a 6-ft. by 8-ft. room in each of these for the tub transformers of the lighting system. Thus it was arranged that 100 standards should be served by each transformer set, and the structures housing these were spaced accordingly. Only one of the transformer stations has been put in service thus far.

Energy comes from the city distributing mains on 2300-volt lines to the transformers, and goes out at 2600 volts on double steel taped No. 8 stranded cable. The wiring arrangement is such that eight 2075-ft. lengths of this cable were used without splices, all connections being made in the terminals within the standards into which the main cable itself is looped. The current is carried in the distributing lines at 6.6 amp, and a single 400-watt tungsten lamp is used on each standard in a 20-in. globe.

The standards are of concrete, octagonal in cross-section and 12 ft. in height. The base is 2 ft. square on a foundation set 4 ft. in the ground. The diameter at the top of the standard is 5½ in. A 1½-in. pipe in the center carries both cables, which are passed through a

waterproof joint just below the top. A No. 8 solid copper wire is joined to each of the stranded cables at the terminals for making connections in the lamp socket. The poles were cast in vertical forms with the small end down, as it was thus possible to use for the first 2 ft. at the top of the pole a mixture of one part cement to two parts of sand, while the regular one-two-four mix was used for the remainder of the pole. After erection, the standards were finished with a neat cement wash.

The cost of the installation, $12,300, was met by funds from the park board under an agreement whereby the city is to provide electricity for lighting. Thus each pole complete in place cost about $135, including its share of the distributing line and transforming equip-



LIGHTING STANDARD ON TERWILLIGER BOULEVARD, PORTLAND, ORE.

ment. The cost of the bare concrete poles was between $27 and $30 each.

The contract for installing the lighting system in its entirety was held by NePage, McKenny & Company of Portland, and the work was carried out under the direction of J. H. Sroufe, Portland manager for that company.

Keeping Account of the Productive Hours

Every electrical contractor knows how much money he pays his workmen, but few can tell accurately what they receive in return for these wages. They know approximately but not definitely, as each would know if he had a time-keeping system such as has been worked out by the Braman Electric Company of Perry, Ia.

In operation the system is carried out as follows: Each man is provided with "daily time ticket" blanks upon which he indicates his operation for the day. For instance, an employee arriving at the store at 8 a.m. and waiting on retail trade till 9 a.m. draws a line on his daily time ticket as shown herewith. Had he spent an hour on a wiring job he would have drawn a similar mark in the column headed "Pro," indicating productive labor. Non-productive labor, such as sweeping, cleaning, unpacking goods and the like, is classified under the heading "N.-Pro." The column headed "D-H," signifying dead head, is used for time unaccounted for under the other heading and can be used to indicate temporary lay-off.

Summarizing these time slips at the end of each

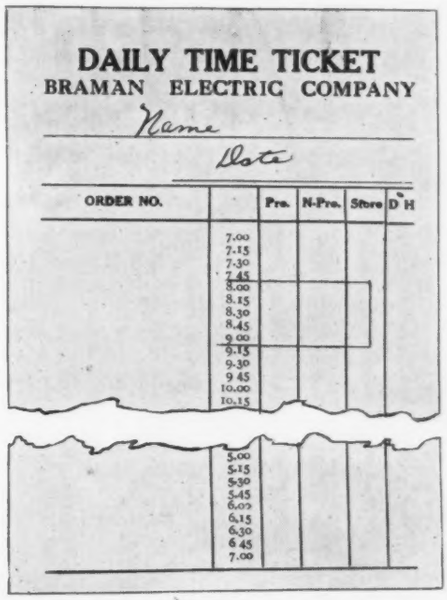


FIG. 1—DAILY TIME TICKET

month gives the company's executive a definite idea of what each workman is worth as a producer, and, taking all extenuating circumstances into consideration, salaries can be regulated accordingly. The amount of productive time put in by the entire working force is also calculated each month, and a record of the percentage of productive time is kept with the monthly cost summary. In this way the individual time tickets spur the

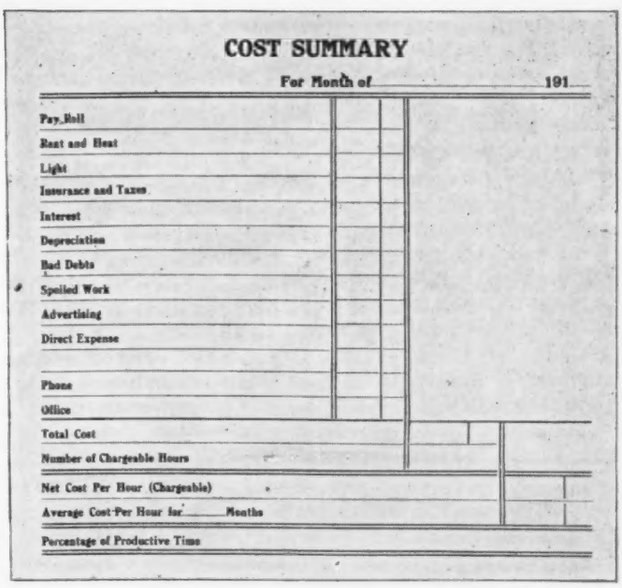


FIG. 2—MONTHLY COST SUMMARY

men to greater productive effort, and a comparison of monthly percentage records guides executive action to increase general productiveness. Other interesting data kept on the cost summary blank are: number of chargeable hours, net cost per hour (chargeable), and average cost per hour.

Manufacturers Assist Central Station in Increasing Appliance Loads.

The Denver (Col.) Gas & Electric Company increased its appliance load considerably recently by offering to give a large percentage of all revenue obtained from appliance sales to the two most popular charitable organizations. Although Denver had been intensely can-

SALESMEN READY FOR DAY'S WORK

vassed before, it is interesting to note that 5689 additional appliances were sold and placed on trial by this method. In this campaign the electric-service company was assisted by the General Electric Company. Publicity was given to the campaign by conducting a voting contest for the most popular charity organization in the city. The organization receiving the most votes received 60 per cent of the charity fund, and the second highest received 40 per cent. By thus showing the people that profit on sales was not the reason for selling appliances, the electric-service company has placed a very attractive diversified load on its lines without additional investment in feeders, transformers or meters.

The city was thoroughly canvassed by dividing it into districts, each of which was visited by two salesmen. The appliances used by these salesmen for demonstration purposes were carried with them in the carriages used for transportation. During the campaign the central-station appliance salesroom was attractively decorated, and the devices were demonstrated by saleswomen. Numbers were distributed every afternoon, and to the person receiving the prize-winning number an electric-iron toaster or grill was given. To obtain these numbers persons were required to fill out tickets with their names and addresses. This information furnished a valuable list of "prospects" who were known to be interested in electrical appliances. The accompanying illustration shows a sign on the electric-service company's building advertising the campaign, together with the salesmen ready to start out on their new-business-getting trips.

One Solution of the Donation Evil

Contractors and dealers in electrical supplies and apparatus are continually being approached by persons interested in charitable schemes who solicit the donation of money and electrical goods "for the benefit of the cause" they happen to be at the moment promoting. After several years of patient experience with this class of solicitors, who are usually women, one electrical dealer who is otherwise a generous giver has set the hard-and-fast rule that hereafter his store will make no donations but will furnish to any worthy charitable movement at their cost price any appliances selected.

In the same way, a firm stand has been taken on the evil of free wiring of churches, one of the unreasonable demands often made on contractors by friends and good customers. Hereafter this contractor offers to wire on request any church or charitable institution at cost, charging only the bare material and labor costs, plus the "overhead" of supervising the job.

Electricity in a Confectionery Shop

On each of the sixty-odd tables in the handsome candy shops of Mr. J. George Smith in the twin cities of St. Paul and Minneapolis is a standard extension desk telephone surmounted by an electric candle-fixture bearing a 15-watt lamp. Referring to a handy table directory or menu, the customer chooses his order, lifts the receiver from its hook, "phones in" the number, and in less than a minute one of the white-aproned attendants has placed the order on the table.

Mr. Smith is a firm believer in "the electric way," and the 600 lamps in each of his stores burn continuously from 8 a. m. to 11 p. m. And if, even after that hour, some late home-goer wishes to show a friend the attractions of the store with all its lighted tables he has only to press a button in one of the window signs and the whole store is automatically lighted up.

In addition to the table candle-lamps, which are mounted on extensions built on the standard desk telephone sets, there are numerous fixtures, and spans of 10-watt units are festooned around the sides of the room on miniature "white-way" lighting fixtures. The circuits for the table lamps are brought up in conduit and end in plug receptacles, from which silk-covered cord is taken into the base of the sets with the telephone wire and up through the standards to the cande-

AN ALL-ELECTRIC CONFECTIONERY SHOP IN MINNEAPOLIS

labra outlets. Each table telephone is a full-fledged branch line over which the customer may call any outside telephone. According to the proprietor, the table telephones effect a considerable saving in the time of employees who would otherwise be required to make two trips to the customer's table, besides waiting a longer or shorter period for the patron's choice to be expressed.

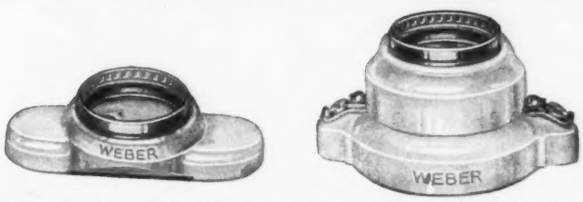
NEW APPARATUS AND APPLIANCES

Interchangeable Sockets

Various types of interchangeable key, keyless, pull and wall sockets, which can be used with a number of different kinds of bases, are being made by the Weber Electric Company, Schenectady, N. Y., for which Henry

FIGS. 1, 2 AND 3—KEY, KEYLESS AND PULL SOCKETS

D. Sears, 131 State Street, Boston, Mass., is general sales agent. These devices are of the locking type and are similar in construction to the electrolier sockets described in the ELECTRICAL WORLD of Oct. 3, 1914. The caps of these sockets are equipped with a reinforcing ring, the upper edge of which is very sharp. Eight



FIGS. 4 AND 5—BASES USED WITH INTERCHANGEABLE SOCKETS

projections on the shell come in contact with this sharp edge, thereby preventing the separation of the two parts of the shell. Four projections are provided on the shell which come in contact with a series of openings in the cap, thus preventing the shell from turning in the cap. Various types of straight caps, angle caps, pendent and strain-relief caps, bases for concealed and open work, and those used with conduit, metal molding and 3-in. and 4-in. outlet boxes, are utilized with these sockets.

Closed Glass Bowl for Nitrogen-Filled Lamps

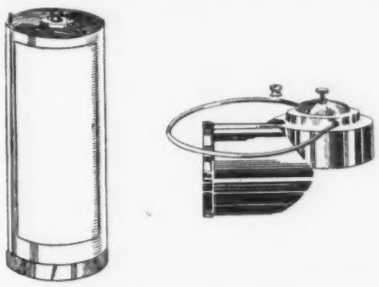
The glass bowl shown herewith is equipped with a glass top and is designed particularly for use

GLASS BOWL FOR HIGH-EFFICIENCY INCANDESCENT LAMPS

with nitrogen-filled lamps. The cover is so made that it is unaffected by high temperatures and therefore is well adapted for use with gas-filled lamps. The glassware is decorated as shown and is translucent. The absorption of the light by the "nubolux" fixture, as the bowl is called, the manufacturers declare, is comparatively small. Bowls of the above type are being made by the Lensed Electric Shade Company, 100 Warren Street, New York, with diameters of 8 in., 10 in. and 12 in., with which tops are used with diameters of 8.75 in., 10.75 in. and 13 in. The depths of these bowls are 8 in., 9.5 in. and 11 in. respectively. The respective depths of the tops are 3 in., 3.25 in. and 4 in.

Lantern Attachment for Dry Cell

A lantern attachment which can be slipped over an ordinary dry cell, as shown in the accompanying illustration, and fastened by means of the battery binding post, has been developed by the Burchwell Manufactur-



DRY-CELL LANTERN ATTACHMENT

ing Company, St. Louis, Mo. The device is of brass and is provided with a brushed-brass finish. A lens is provided for diffusing the light in every direction. A metal reflector with a burnished-silver surface is also utilized. The lantern will throw the light for a distance, it is declared, of more than 300 ft. The lamp is operated by means of a screw switch on top of the attachment. This switch is shown in the illustration.

Battery for Automobile Lighting and Ignition Service

An improved lead battery designed for lighting and ignition service for automobiles and also for motorboats, stationary gas and gasoline engines has recently been brought out by the Electric Storage Battery Company, Philadelphia, Pa. The accompanying illustration shows the battery with one cell cut away to show its interior

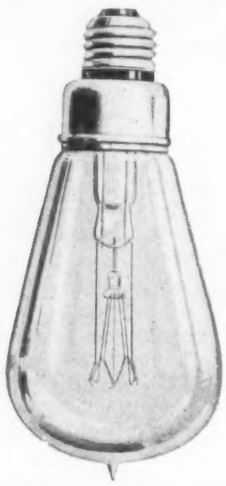
BATTERY WITH ONE CELL REMOVED

construction. Each cell is a separately sealed unit, making it unnecessary to cover the entire top of the battery with sealing compound. Packing compound is also unnecessary. The individual cells have flanged covers,

providing a channel for the sealing compound. The gas vent and filling aperture are so designed that the amount of water that can be poured into the cells is limited to that needed to replace the water lost by evaporation. In filling, water is poured until the liquid rises in the filling neck. The plug is then replaced and tightened. Only one-quarter turn is required to loosen and remove or to replace and tighten this plug. The terminals are of acid-resisting material and are as convenient to handle, the manufacturers claim, as ordinary binding posts. The separators are of treated wood. The cases are of hard wood and are equipped with loop handles.

100-Watt and 200-Watt Nitrogen-Filled Lamps

Nitrogen-filled lamps with ratings of 100 watts and 200 watts which are equipped with ordinary Type S 24½ and S30 Edison screw bases are being made by the Lux Manufacturing Company, Hoboken, N. J. This



200-WATT NITROGEN-FILLED LAMP

lamp, the manufacturers claim, is efficient and sturdy and does not get extremely hot. The 100-watt lamp at 110 volts to 120 volts takes 0.75 watt per candle-power. In operating this lamp it is always necessary to have the tip down, and the lamp must be in a vertical position.

Attachment Plug with Split Bushing

The cap of the small separable attachment plug shown herewith is provided with a composition strain-relief split bushing, which when threaded into the top of the

ATTACHMENT PLUG WITH SPLIT BUSHING

cap serves as a handle for withdrawing the plug from the receptacle. The split bushing grips the cord tightly, it is declared, and relieves the binding screws from strain, making unnecessary the tying of a knot. The device is rated at 660 watts at a pressure of 250 volts. The cap is of composition material and is interchangeable with attachment plugs, wall and flush receptacles of either the "T" slot or small, contact type, made by Harvey Hubbell, Inc., Bridgeport, Conn., the manufacturer of the device. The base is either of glazed porcelain or composition material.

Kerosene Torch and Fire-Pot

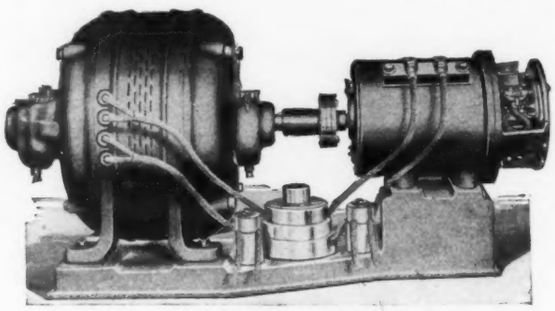
An improved kerosene fire-pot and a quart-size and a pint-size kerosene torch have recently been placed on the market by the Clayton & Lambert Manufacturing Company, Detroit, Mich. The manufacturers declare that the burners are equipped with generators which superheat the kerosene gas before it is burned, producing perfect combustion of the fuel and enabling the user to secure a clear blue flame free from smoke. All parts are easily accessible for cleaning and each device is provided with a cleaning needle. The devices are

FIGS. 1 AND 2—KEROSENE FIRE-POT AND TORCH

equipped with automatic brass pumps for supplying air pressure. The filler plug at the top of the tank is made with an air-valve screw which releases the air pressure and extinguishes the flame. The kerosene fire-pot, illustrated in Fig. 1, is of heavy drawn steel with bottom and all fittings welded and not soldered. A quart-sized torch is illustrated in Fig. 2 and is equipped with a brass burner.

Charging Set for Small Batteries

A motor-generator set designed for charging the small storage batteries commonly employed for auto-



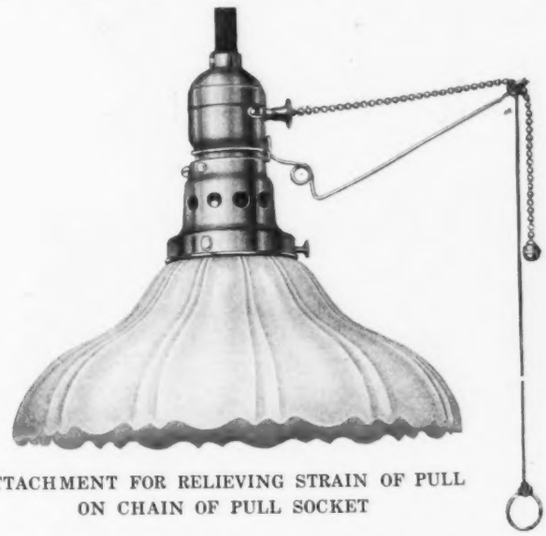
AUTOMOBILE-BATTERY CHARGING OUTFIT

mobile lighting and ignition has recently been developed by the Wagner Electric Manufacturing Company, St. Louis, Mo. The generator employed is identical with that supplied as a part of the Wagner self-starting sys-

tem for automobiles, and may be supplied for charging either 6-volt or 12-volt batteries. The characteristics of the generator are said to be such that the charging rate is automatically controlled without the use of any external device. A sixty-cycle, single-phase motor designed to operate on either 110 volts or 220 volts forms a part of the set. A direct-current motor may be supplied for operation on 110-volt or 220-volt direct-current circuits. A simple snap switch controls both the motor and generator circuits.

Attachment for Pull Sockets

In the accompanying illustration is shown a device for lifting the chain of a pull socket and relieving the socket of the strain when the chain is pulled. The device will

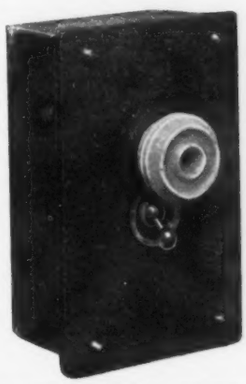


ATTACHMENT FOR RELIEVING STRAIN OF PULL ON CHAIN OF PULL SOCKET

fit any type of shadeholder, the manufacturers declare, and pulls at any angle. No screws are required, as it is snapped on the shade holder. The attachment is being made by the Empire Engineering & Supply Company, 227 Fulton Street, New York.

Interlocking Switch Plug

An interlocking switch plug which is mounted in a cast-iron box and is designed for use with conduit installations is shown in the accompanying illustration. When the plug is inserted in the socket and the switch



5-AMP INTERLOCKING SWITCH PLUG

is placed in the "on" position the "dolly" lies over the extended flange of the plug, thus making it impossible to withdraw the plug without first placing the switch in the "off" position. From the illustration it can be seen that it is impossible to insert the plug while the switch is on, and also that the pin sockets are dead when the plug is withdrawn. The device shown herewith is rated at 5 amp and is mounted in an enameled box fitted with a black-fiber cover. The box is 5 in. by 3 in. in size. A 5-amp device is also made which is placed in a box equipped with a plain polished-brass cover. The interlocking switch plug is being made by Simplex Conduits, Ltd., 116 Charing Cross Road, London, W. C., England.

Portable Fault Localizer

An instrument which is designed to locate the point where a cable is grounded, the per cent of length of defective cable being read directly off the dial, has recently been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The device is an application of the Wheatstone bridge with all the necessary apparatus contained in a portable case wired for connection to the circuit to be tested. When using this instrument it is assumed that

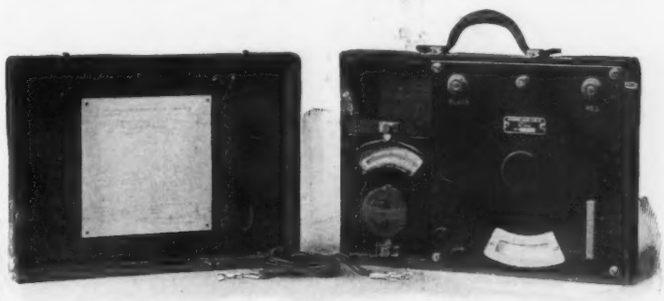


FIG. 1—TESTING OUTFIT FOR FINDING POINT OF GROUND IN CABLE

the cable is grounded at only one point, and that a parallel conductor of the same length and resistance as of the faulty cable is available. After proper connections are made, a dial on the instrument is revolved by means of a knob in the middle of the device, until the galvanometer with which it is equipped shows no deflection, at which time the key is closed. The reading of the meter then gives the percentage of length of the feeder from the point where the test is being made to the point where the ground has occurred, assuming the total length of the feeder to be 100 per cent. There are two scales; one is colored black, and the other red. The red scale indicates that the ground is on the conductor connected to the binding post, which is also marked in red, and the black scale indicates that it is connected to the binding post marked black. Direct-current energy only is used in these tests. The apparatus is inclosed in a polished wooden case. Two types of in-

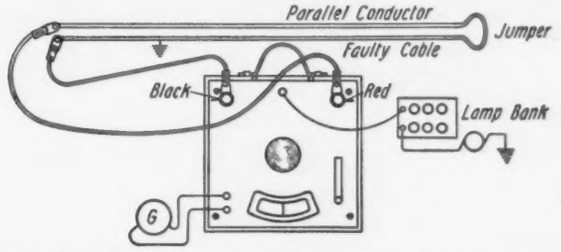


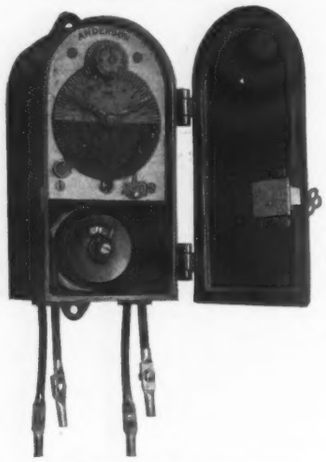
FIG. 2—METHOD OF CONNECTION TO FAULTY CABLE

strument are being made, one of which contains a galvanometer and the other is used with a separate galvanometer. Variable-resistance arms are provided which consist of two loops of low-resistance wire at-

tached to the side of a revolving disk upon which the dial is attached, so that contact is made from two brushes attached to the case and connected to the galvanometer terminals. As the disk is revolved the point of contact between the brushes and the resistance loops is varied, as in the slide-wire bridge. The dial is calibrated in percentage of the length of conductor tests, so that the reading is direct. The galvanometer is highly sensitive and is equipped with a "uni-pivot" bearing which does not have to be leveled to take readings.

Time Switch

A time switch has recently been developed by the Albert & J. M. Anderson Manufacturing Company, 289 A Street, Boston, Mass. The switching mechanism is of the snap type, as shown in the accompanying illustration, and indicates whether the circuit is closed or open. The clock and other parts of the device are similar in design to time switches made by the above

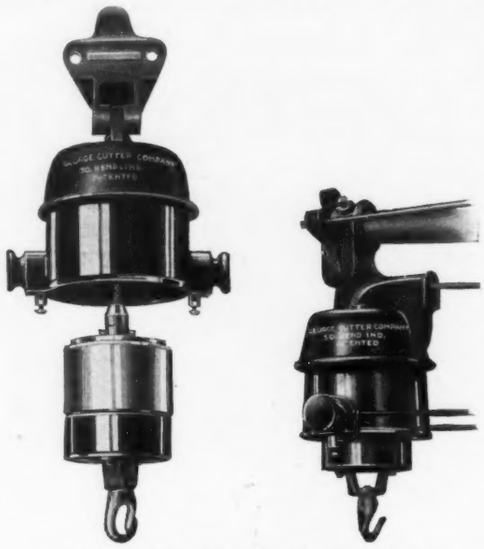


INCLOSED TIME SWITCH

company which have already been placed on the market. The switch was designed, the manufacturers declare, to meet the demand for a medium-priced switch with smaller rating than the standard 25-amp switch made by the Anderson company. The over-all dimensions of the case in which the switch is inclosed are 6 in. long, 4⅛ in. wide and 4 in. deep. The time switch is being made with rating of 10 amp in the double-pole, single-throw and three-pole, single-throw types and with rating of 5 amp in the single-pole, double-throw type for 600 volts and the double-pole, double-throw type for 250-volt two-rate meter service.

Cut-Out Pulley

The cut-out pulley shown in the accompanying illustration consists of an iron canopy with a porcelain housing which contains two contact fingers and an automatic locking sleeve. The plunger that travels in this sleeve supports a lower base having contact rings connected to the terminals of the lamp. The contact fingers in the upper porcelain housing are connected to the line wires. The hoisting rope is fastened to the plunger carrying the lower contact rings. Beneath the porcelain ring is a hook for supporting the lamp. By pulling the hoisting rope the plunger is brought up inside of the sleeve, and when the rope is released the plunger is locked in place. As the plunger travels upward in the sleeve the contact rings in the lower porcelain base separate the contact fingers in the upper porcelain housing. In this way the lamp is connected to the line wires and a clean surface is maintained by the rubbing action of the contact finger on the rings. The device is designed especially for street lamps arranged either in



CUT-OUT PULLEY CONNECTED TO ARM

series or multiple and operating on direct current or alternating current. The device, however, is adapted also for interior work, for which purpose a special canopy and supporting plate are utilized. The line wires leading to the lamp are drawn up taut and are never lowered. The lineman is safeguarded and defective lamps can be replaced while the others are running.

The cut-out pulley is being made by the George Cutter Company, South Bend, Ind.

Washing Machine of Inverted-Drive Type

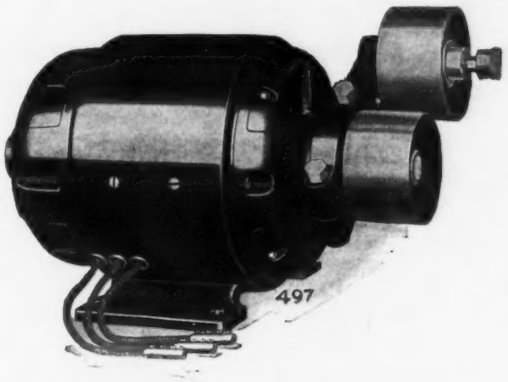
An electric washing machine having the agitator, or dolly, coming up through the bottom of the tub instead of on the lid is shown in the accompanying illustration. The entire mechanism is underneath the tub, there being no moving parts on the lid or sides of the tub. The washer can be lowered or raised as desired. The machine is equipped with a revolving wringer which can be locked at any position according to size of the tub. The wringer is provided with a wide reversible drainboard and wrings the clothes in either direction into and out of four tubs. By raising or lowering a conveniently placed lever the machine is thrown in or out of gear. A

ELECTRIC WASHER WITH INVERTED DRIVE

safety lever is mounted on the wringer, so that it can be instantly stopped or reversed. The washing machine is operated by a 1/6-hp motor and is being made by the Haag Brothers Company, Peoria, Ill.

Steel-Frame Direct-Current Generator

In the accompanying illustration is shown a direct-current generator recently developed by the Robbins & Myers Company, Springfield, Ohio. The machine is built in sizes with ratings from 0.24 kw to 1.5 kw and is equipped with a cast-steel frame which gives it a



SMALL DIRECT-CURRENT GENERATOR

light, compact construction. Generators of this type are built for low-voltage service for charging storage batteries and also for service requiring higher pressures. They are particularly adapted, the manufacturers declare, for farm-lighting plants, and can be equipped with a flywheel pulley as shown in the illustration for gasoline-engine drive. The bearing bracket on the commutator end of the machine is so constructed as to give easy access to the commutator and brushes. Use is made of oil-ring lubrication. The leads are brought out through holes in the frame, which are bushed with a heat-resisting insulating material. Sliding bases are provided with adjustment screws for adjusting the belt tension.

Adjustable-Speed Single-Phase Motor

Extremely fine gradations of speed control over a total range of more than three to one are secured in the new adjustable-speed single-phase motor developed by the Kimble Electric Company, 634 North Western Avenue, Chicago, in which the entire motor circuit is rapidly and intermittently broken for longer or shorter intervals by a centrifugal governor mounted on the motor shaft. The motor itself is of the compensated series type and the setting of a hand-wheel controls the speed of the machine by adjusting the position of the renewable contact pieces against which the inclosed flyball governor acts.

In its speed characteristics this new single-phase motor in some respects resembles the multi-voltage-control direct-current motor, in which the horse-power output increases with increasing speed. From no load to full load, at any speed, the speed drop is said to

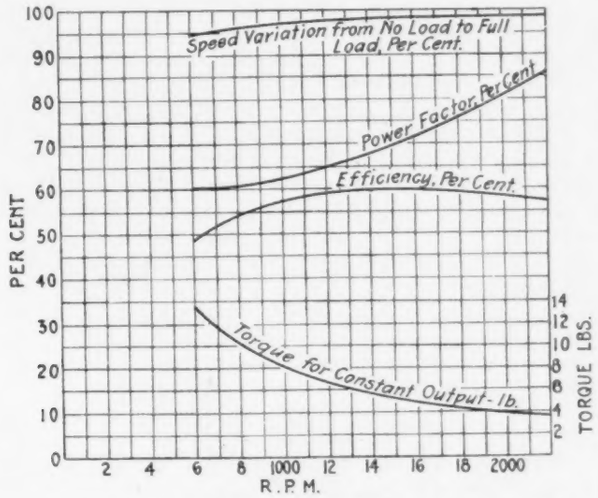
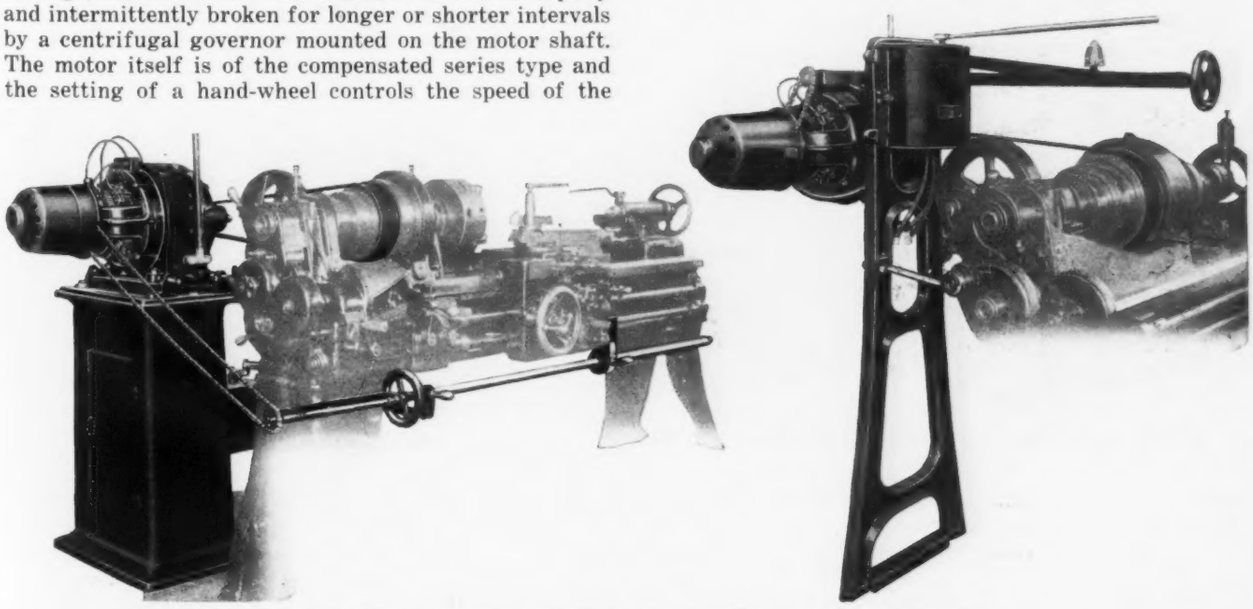


FIG. 3—PERFORMANCE CURVES FOR 1.5-HP MOTOR

be less than that of an equivalent constant-speed induction motor, enabling the new motor to fulfil the exacting speed requirements of machine-tool service. By short-circuiting the motor windings a powerful dynamic braking action is obtained. Unlike the direct-current motor, however, this retarding action is not brought into play at very low speeds, as, for example, that involved in turning the tool spindle when placing work in the chuck. One form of controller arranges for reversing the motor, with speed control in either direction. At present the new motors are made only in sizes from 1/6 hp to 2.5 hp, the standard speed range being from 600 r.p.m. to 1800 r.p.m. for all sizes, although small units with speed changes of one to six are furnished.

Two types of mounting are furnished with the motor,



FIGS. 1 AND 2—MOTOR MOUNTED ON PEDESTAL AND ON CANTILEVER

either being well adapted for driving a lathe or similar machine. In one type the motor is set on slide rails on a flat-topped pedestal fastened to the floor, the controller box being at the side of the pedestal. Space within the pedestal body is provided with shelves for the storage of tools, etc. The motor is then belted to the largest or next-largest cone step, an arrangement which with the back gear gives every speed required. This mounting has the advantage of keeping all motor vibration away from the lathe. In the other type of mounting the motor is placed at the rear of a swinging frame, the lower end of which is attached by a hinge to the floor so that the whole assembly may be swung away from or toward the lathe to adjust the belt tension. This adjustment is made as needed by a distance piece of adjustable length between the cantilever and lathe. The controller box is mounted on the front of the frame. This type of mounting is more compact than that first described.

With either of the types of mounting the attachments included with the motor, are as follows: Sprocket, chain, speed-adjustment wheel, shaft and bracket, two start, stop and reverse levers with shaft, brackets for attaching to the apron and frame of the lathe, and connecting link between the apron and controller.

Portable Lamp

One of the features of the portable lamp shown herewith is a universal joint by means of which the lamp can be turned in any direction desired. The lamp is provided with 10 ft. of cord and all slack cord is wound around a device concealed in the base. The cord is fitted with a push-plug which is snapped into the socket, no screwing into place being necessary. Use is made of a Cutler-Hammer push-button socket. The shade fits over the bulb as shown and is easily detachable; it is 5 in. in diameter and 2.5 in. high. The diameter of the base is 5.75 in., and with an ordinary 60-watt tungsten lamp the total height is 12 in. A clamp is attached to the base, which can be fitted to articles with thicknesses varying from ⅛ in. to 3.75 in. The lamp is being placed on the market by the Leindorf Electric Light Company, 220 West Forty-second Street, New York.

PORTABLE LAMP WITH UNIVERSAL JOINT

Panel for Controlling Battery of Washing Machine

In Fig. 1 is shown an automatically operated remote-control panel recently built for the Adams Laundry Machinery Company, Troy, N. Y., by the Sundh Electric Company, 548 West Twenty-third Street, New York. The panel is designed for use with a battery of twelve washing machines to be installed in a New York hospital. The washers are operated by 3-hp, two-phase, 220-volt induction motors, and the apparatus is so designed that not more than two washers will start or reverse at the one time.

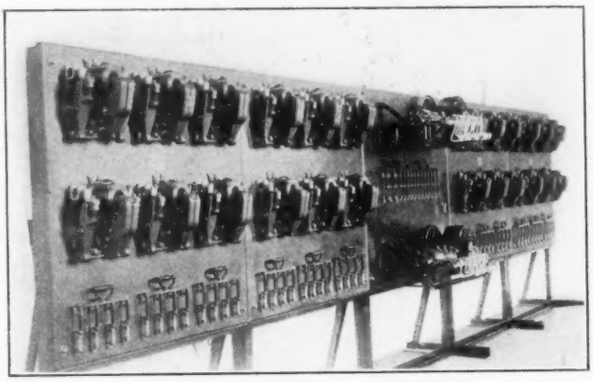


FIG. 1—CONTROL PANEL FOR OPERATING TWELVE WASHING MACHINES

In Fig. 2 there is illustrated the arrangement of timing devices, each of which will control the timing and operation of the twelve washers. Two timing devices are employed, an extra set being provided in case of break-down. Use is made of an overthrow switch as shown so that either device can be used as desired. The timing devices are operated by a 1/30-hp, single-phase motor.

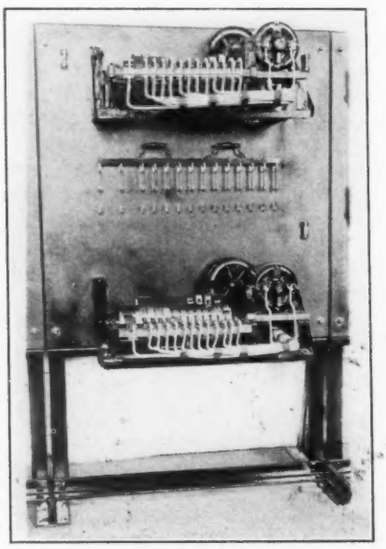


FIG. 2—TIMING DEVICES

CURRENT NEWS SECTION

Associated Manufacturers of Electrical Supplies

The organization committee representing the electrical manufacturers who met at the Hotel Biltmore, New York, on Jan. 12 has prepared plans for the formation of an association of electrical manufacturers. The committee, which comprises Messrs. W. T. Pringle of the Pringle Electric Manufacturing Company, W. Cary of the Westinghouse Lamp Company, N. C. Cotabish of the National Carbon Company, G. A. Craigin of the American Steel & Wire Company, D. C. Durland of the General Electric Company, E. R. Harding of the Holtzer-Cabot Electric Company, J. W. Perry of the H. W. Johns-Manville Company, W. C. Robinson of the National Metal Molding Company, and J. E. Way of the R. Thomas & Sons Company, will report to the manufacturers at the Hotel Biltmore, New York, on March 9 at 10:30 a. m.

Mr. R. K. Sheppard, chairman of the meeting, has sent out invitations to all manufacturers of electrical supplies and materials entering into the manufacture of electrical equipments, and every effort is being made by the manufacturers already in touch with the movement to interest other manufacturers also. It is hoped that a large attendance representing all manufacturers will be present so that the widest discussion may be obtained and the organization be launched with the feeling that all interests have had a voice in its formation and that it will be thoroughly representative in its aims.

At the same meeting the nominating committee which was appointed Jan. 12 will report a list of names for a representative committee of business and technical experts to examine thoroughly "concentric wiring" and the problems allied thereto.

While the objects of the association will be manifold, its chief function will be to provide the machinery for concerted action in matters which vitally interest the entire electrical industry. It will not seek to usurp any of the prerogatives of the Electric Power Club or the Electrical Manufacturers' Club, but will deal with the larger questions affecting the industry.

By the form of organization each section of the industry will secure its own control of matters pertaining to such section without undue interference by any other section, and manufacturers can secure co-operative effort and the results therefrom in their dealings with the government, the Underwriters' Laboratories and the other associations now existing in the electrical industry. In many other ways much common benefit will result from the associated efforts of the electrical manufacturers.

Failure of Water-Power Bills in Congress

When the third session of the Sixty-third Congress came to an end automatically under the statute on March 4, the water-power bills had not been passed. It was thought in Washington until the afternoon of March 3 that there might be a chance to call up the so-called Shields bill, otherwise known as the Adamson bill, in the Senate, but this measure, which provides for dam sites, would have had to go to conference, and it was realized that the House of Representatives, after having passed it as the Adamson bill, probably would not have agreed to it in the altered shape. The Ferris bill, reported from the Senate public lands committee, after having been passed by the House, likewise failed. This measure provided for the leasing of water-power sites on the public domain.

As all legislation proposed and not enacted dies with the end of a Congress the House will have to pass both bills again, and as the personnel has been changed considerably and many new men will take seats, considerable work is likely to be involved in passing the bills again.

Among the many new Senators will be Senator Husting of Wisconsin, who is known as a water-power authority. He is the author of the Wisconsin water-power laws, which are the subject of attack in that State.

United Gas Improvement Company Investigation

Newspaper interviews published recently which describe the only differences between the United Gas Improvement Company of Philadelphia and the Department of Justice at Washington as being in connection with the street-lighting business of the company are received at the Department of Justice with reserve. At the office of Mr. George Carroll Todd, assistant to the Attorney-General, who is in charge of an investigation that has been made of the company's affairs, it is said that the department does not care to say that the only differences to be adjusted are differences connected with the street-lighting business of the company, and that it may not properly be said that the department is not interested in the affairs of the Welsbach company.

The department confirms a recent report from Philadelphia that the company is endeavoring at present to reorganize its corporate control, and the latest reports from Washington are that the department is still awaiting the receipt from Mr. Samuel T. Bodine, president of the company, of documents showing just what this control has been, is and will be.

Recently the company has drawn attention to itself in Washington by reason of the fact that engineers connected with its gas-plant-building branch have made recent inspections of the Washington Gas Light Company plants. It was reported in Washington that the United Gas Improvement Company had obtained control of the Washington company, but Mr. Howard Reeside, president of the Washington company, denies this.

Organization of New Mexico Electrical Association

The New Mexico Electrical Association was organized at Albuquerque on Feb. 15 with twenty-three members, electrical men from all parts of the State. The sessions were held at the Commercial Club and the following officers were elected: President, Mr. C. M. Einhart of the Roswell Gas & Electric Company; vice-president, Mr. A. F. Van Deinse of the Albuquerque Gas, Electric Light & Power Company, and secretary-treasurer, Mr. E. A. Thiele of the Roswell Gas & Electric Company. On the night of Feb. 16 the Jovian Order held a banquet at the Alvarado Hotel followed by a rejuvenation at which all twenty-three electrical men were initiated. The delegates were also taken on an automobile trip through the city and made an inspection

of the electrically equipped domestic-science department at the University of New Mexico.

Following the final session of the association on Feb. 16, the members were entertained at dinner at the Country Club.

New York Jovian Rejuvenation

At the rejuvenation of the Jovian League of New York held at the Hotel Martinique on March 3 forty new members were initiated into the order. About 225 Jovians and friends sat down to dinner, arrangements for which were made by Mr. Frank E. Watts, tribune, and Mr. James H. Betts, statesman for New York. During the evening the guests were entertained by vocal selections and dancing and by a successfully staged "badger" fight, which was allowed to proceed in spite of a vehement protest. Among those present were Mr. Holton H. Scott, president of the National Electric Light Association, and Mr. J. C. Vogel, thirteenth Pluto.

The degree team, which was under the direction of Mr. C. L. Hight as Vulcan, was composed of the following: Messrs. Roy E. Schaulin, Jupiter; J. W. Morey, Neptune; C. L. Hight, Vulcan; James J. Sheeran, Pluto; George Feher, Mars; A. E. Farrenkopf, Hercules; William J. Clifford, Apollo; and H. W. McGraw, H. C. Lawrence, L. E. Latham, Frank W. Burke, William C. Chapman and Thomas Christianson, imps.

Plans of the Federal Trade Commission

The new Federal Trade Commission, four members of which were confirmed in executive session of the Senate late on the night of March 2, intends to "go very slow" and to proceed upon the dominant idea of being an aid to business. The commission intends to devote considerable time to study of the question of whether it will be advisable for laws to be framed permitting small producers and manufacturers to co-operate for foreign trade against competitors in other countries. The commission expects to answer in the very near future a great many questions which have already been raised with the Bureau of Corporations and with Mr. Joseph E. Davies personally.

This information has been obtained by a representative of the ELECTRICAL WORLD from authoritative Washington sources. At the same time it became known that many large manufacturers have the Clayton law under consideration. The American Wringer Company has decided to readjust its selling plan in order to avoid any possible violation. This company has sent copies of the new laws to hardware dealers, calling attention to the fact that readjustments are necessary. That this has been done in advance of the organization of the commission is pointed out in Washington as evidence that business men are showing a spirit of accommodation which cannot fail to make the work of the commission easier.

Mr. George Rublee, of Cornish, N. H., whose nomination to the commission has not been confirmed by the Senate, will get a recess appointment from President Wilson. During the debate on the name of Mr. Rublee in the executive session of the Senate, Senator Gallinger of New Hampshire opposed Mr. Rublee. The four appointees confirmed were Messrs. Davies, Edward N. Hurley, W. J. Harris and W. H. Parry.

It will be necessary, it is said, to appoint a number of special examiners and investigators. How large the payroll is to be has not yet been determined, but an enormous amount of work is to be done. Congress has made appropriations as follows: $50,000 for the commissioners, plus $5,000 for the secretary; $18,333 for the commissioners and the secretary to July 1, 1915, as a deficiency item, the previous items of $55,000 being for salaries from July 1, 1915, to June 30, 1916; $10,000 for rent; $15,000 for printing, and $300,000 for general expenses. All of this total of nearly $400,000 has been made available immediately. The old Bureau of Corporations had an appropriation of $254,000.

Hydroelectric Bill in West Virginia

The West Virginia Senate has passed the Hinerman-Gregory bill, which seeks to place the control and regulation of hydroelectric companies with the Public Service Commission and effect greater development. The vote stood 23 to 6. There was considerable opposition from the minority, and one opposing senator, who explained that he would vote for the bill because it is better than present laws, said that he believed no permits would be granted under the new law, as there had been none under the old law. Some higher authority, he said, seemingly prevented the issue of permits. The bill will be returned to the House of Representatives for approval of the Senate amendments.

Under the bill permits for dams can be granted only to West Virginia corporations. This provision precludes development by a number of companies which have been endeavoring to secure permits from the Public Service Commission for two years. Authority is given the State to employ experts to supervise the construction of dams, but there is no limit to the height.

The bill prohibits the transmission of electrical energy beyond the limits of the State and requires that hydroelectric companies secure the consent of the commission for building transmission lines. It provides that after fifty years the State may purchase plants for a consideration to be fixed by arbitration, but the price must not exceed the original cost of construction.

Representatives of companies which have been seeking rights in the State say that the provisions are so stringent that properties cannot be financed and that development will be delayed.

Developments in Cleveland Municipal Situation

The municipal plant at Cleveland, Ohio, has announced a new wholesale motor-service schedule which will reduce the minimum charge from 1 cent to 0.6 cent per kw-hr. Director of Public Utilities Stage stated that this rate is lower than the latest rate of the Cleveland Electric Illuminating Company up to a point where a consumer with a 3000-kw connection uses energy fourteen hours each working day. It is announced that the new policy of the department is to secure large motor-service contracts instead of building up the load gradually, as planned at first. Mr. Stage declared that the large business will enable the city to extend the distribution system to all residence sections without heavy cost to taxpayers, and that the way to get the large business is to make rates attractive.

A duplicate of the old Mills bill has been introduced in the Ohio Legislature by Senator William Behne of Williams County. It provides that bonds issued for municipal utility plant construction or the purchase of such plants shall be a lien upon the general tax duplicate, instead of upon the utility only, as at present. It also removes such bonds from the present law limiting the amount cities may issue and gives municipalities the right to issue securities in unlimited sums for this purpose. Mayor Newton D. Baker of Cleveland is said to approve the bill, as it would make the city free to purchase the Cleveland Electric Illuminating Company property. Under the present law this could not be done.

Work of the Society for Electrical Development

At a meeting in the interest of the Society for Electrical Development, Inc., in New York, on Feb. 25, much of the work of the society was discussed and larger plans for the future were outlined.

Mr. A. J. Edgell of the society staff spoke of the work among department stores to promote window displays and the use of busy sections of the stores for attractive presentations of electrical appliances. The society has sent thousands of letters to merchants and chambers of commerce to promote better street lighting. Mr. Edgell has been attending conventions of window-display men all over the country.

Mr. H. W. Alexander of the society staff spoke of the general publicity work, which is being carried on through the trade press, popular magazines and daily newspapers. One of the features of the publicity work is the use of electric-railway cards and miniature stamps. These are designed and printed for the society and are sold at low prices to central stations.

Mr. J. M. Wakeman, general manager of the society, in going into details in regard to its activities, called special attention to the formation of co-operative committees representing central stations, contractors and jobbers in various cities. These committees carry the work of the society into the community. The committees in the larger cities extend their influence to smaller places and thus do much to promote electrical progress.

Mr. James H. McGraw, president of the McGraw Publishing Company, Inc., said that certainly a great deal has been accomplished by the society in the last two years and excellent plans have been laid for the future. The work being done is the kind that the industry used to dream about before the present organization came into existence. In a commercial sense service is the largest word in the language and the society is rendering a service. There is something unusually attractive to the public in electricity. There is more about electricity that the public will be glad to read than there is available on any other subject. If the society did not do anything else but promote good feeling between the central station, jobber and contractor it would justify its existence.

Mr. McGraw said that there is a lack of merchandising knowledge in the electrical industry. The industry as a whole has not yet learned the science of merchandising, and the society can do much to teach the elements of merchandising to the electrical field.

Mr. Henry L. Doherty, president of the Society for Electrical Development, in speaking of new-business methods, said that there is a woeful lack of education somewhere. Trained salesmen are not retained by companies as they should be. In the early history of the Denver company sixty-nine salesmen were lost in less than two years, and new men had to be kept in training all the time. Since then conditions have changed radically, but there is still room for material improvement. The industry has reached a point where intensive cultivation in certain parts is necessary. The results of intensive salesmanship in one city flow beyond the limits of that city and benefit other places. Every central station is entitled to some advantage from an overflow of this kind from its neighbors, and if everyone undertakes intensive cultivation the entire industry will be benefited.

One idea expressed by Mr. Doherty is that a campaign should be undertaken to introduce, for instance, electric-motor drive in the machine-tool trade, making a complete installation in a city. Another idea is to find an industry which is willing to be equipped electrically "to the last gasp." If a hotel should be so equipped, it could be advertised so successfully among electrical people that that in itself would make it prosper. Another plan is to have an electrical feature for every convention held. There should be an electrical feature on every program of an association meeting anywhere in the country. Another idea is that the electrical industry should do more to promote railroad electrification. This is now mainly a matter of financing, but the society can do much to further progress. Any form of manual labor can be eliminated or reduced by electrical energy, and this fact is an argument and an opportunity for promotion work. In all work of this kind there should be friendly feeling and co-operation. Harmony is needed to make this large national situation healthful.

Montana Power Development Described

Mr. John D. Ryan, president of the Montana Power Company, addressed more than 100 bankers and investors at the Exchange Club, Boston, Mass., on Feb. 27, upon hydroelectric development in Montana. The company furnishes 85 per cent of the lighting service and 95 per cent of the hydroelectric service in a territory larger than New England. There are 28,500 customers, with diversified loads ranging from trunk-line railroad operation and the supply of energy to mines and smelters to small domestic applications. For every dollar of income the company has 70 cents left to pay interest and dividends. Despite the severe industrial depression of 1914, gross and net earnings have increased as shown in the following table:

	1912	1913	1914
Gross	$3,022,964	$3,539,198	$3,778,285
Net after taxes	2,048,136	2,421,424	*2,639,239

*About two and one-half times the interest charges.

The prospective capacity of the company's plants is as follows: Hydroelectric plants now in operation, 101,000 hp; hydroelectric plants under construction (75 per cent completed), 120,000 hp; reserve steam plants, 8000 hp; water-powers undeveloped, in reserve, 133,000 hp; total, 362,000 hp. The system includes twelve hydroelectric power plants and four steam-reserve stations, 1470 miles of transmission lines, complete distribution systems in Great Falls, Butte, etc., and, in addition, undeveloped or partly developed water-powers capable of generating about 253,000 hp, of which 120,000 hp is under construction and 75 per cent completed at the two sites of Great Falls and Thompson Falls. Both of these plants will be furnishing energy in the latter half of 1915.

The primary water-power is to all intents and purposes perpetual and, for the territory covered, well distributed. President Ryan said that with the reservoir capacity it would take a three months' drought even to begin the interruption of business. The transmission system connects Great Falls, Butte, Helena, Anaconda, Boulder, Bozeman, Lewiston, Billings and other cities, and the titles to rights-of-way and other property are as clear as those on any property in New York City. The Anaconda Mining Company has a contract with the Montana Power Company during the life of the mine at $30 per hp-year, while the Chicago, Milwaukee & St. Paul Railway has a ninety-nine-year contract, costing annually a minimum of $550,000. As an example of what the company can earn, the transmission line built in 1913 from Great Falls to Lewiston, at a cost of approximately $158,000, netted $58,000 in 1914.

Mr. Ryan said that the maximum charge for house lighting is 9.5 cents per kw-hr. Service by a 1-hp motor costs about $100 per year. In Billings alone there are 600 electric ranges in service. Last year the company did a business of nearly $4,000,000, with prac-

tically fifty employees. During a walkout of ten days a year or two ago not a wheel stopped, as the company manned its plants with foremen and clerks.

Mr. Ryan said that with 430 miles of the St. Paul railway electrified it would seem that the Northern Pacific, its neighbor, would have to electrify also in order to compete successfully. The company can furnish power to the Northern Pacific for a distance of 500 miles without adding to the existing plants. Moreover, operation in Montana costs the railway company two-thirds less than by coal. The lives of many mines in the State will be as long as that of the company, in Mr. Ryan's opinion, and the older they grow the more energy they will need.

New York Telephone Valuation

The legislative committee which is investigating telephone rates in New York City has made a report to the Legislature recommending a reduction and also urging amendments to the public service commissions law providing for stricter supervision and regulation of telephones. The report says in part: "Telephone service is developing more and more into a monopoly. Universal service is demanded by the public. If such monopoly is to be permitted, then it must be made subject to rigid supervision and regulation by the State. For the protection of the public it is necessary to give the Public Service Commission greater authority than it now possesses over securities, rates, physical condition of property and conduct of the business." The committee recommends that certificates of public convenience and necessity be required for the construction or extension of telephone lines, except for the installation of instruments, and that the exemption of corporations having less than $10,000 capital from supervision be abolished. The committee would give the commission power to compel connections between commercial lines and the exchange of messages with any other commercial line.

Mr. John L. Swayze, counsel for the company, told the committee that a flat 5-cent New York City rate would be granted provided the committee and the Public Service Commission meet the company half-way. The company valued the physical property in New York City at $99,925,934, while Prof. E. W. Bemis estimated it at $65,000,000. Mr. Swayze said that if the company was forced to go to the courts it would make a hard fight. It would insist that all values, tangible and otherwise, be taken into consideration as they should be. The company could not permit the property to be undervalued, for the reason that stock and bonds would suffer a severe depreciation, and it was opposed to the establishment of a precedent in property valuation on the basis used by Professor Bemis.

The rates recommended by Professor Bemis involve reductions aggregating over $3,000,000. He said that profits in New York City taken alone would justify a larger reduction. The temporarily unprofitable character, however, of recent investments of the company in the rest of the State and the fact that a 10 per cent reduction aggregating $2,000,000 was made in February, 1914, and that it is difficult on short notice to make the adjustments necessary for another reduction of more than $3,000,000, render it advisable and for the good of the service, Professor Bemis held, to go no further than he advocated. The report of Professor Bemis was adopted by the legislative committee.

The New York Public Service Commission, Second District, has fixed upon $82,000,000 as a full valuation of the New York City properties of the company. Chairman Van Santvoord announced that the commission thought that 8 per cent was a fair rate of return on the capital investment, taking into consideration the conclusion of the commission that the 4½ per cent of gross earnings which the company pays to the American Telephone & Telegraph Company is excessive and should be reduced to $1 an instrument. Mr. William Temple Emmet, a member of the commission, submitted a minority report favoring a valuation of from $88,000,000 to $90,000,000. He admitted that this would make comparatively little difference in the reduction as the figures of the commission allow a margin over the 8 per cent return.

Mr. Swayze said that he could not answer for his client until the directors acted. He said that the record did not show how much or how little is given for the 4½ per cent rental which the commission would reduce, or how the valuation of $82,000,000 was determined.

Illumination and the Human Eye

Three papers dealing with the relation of illumination to the eye were presented at a meeting of the New England Section of the Illuminating Engineering Society at Boston, Mass., on Feb. 26.

Effects of Radiation on the Eye

In his paper entitled "Effects of Radiation on the Eye" Dr. Louis Bell, Boston, referred briefly to recent investigations in collaboration with Dr. F. H. Verhoeff, of the Massachusetts Charitable Eye and Ear Infirmary, upon the physiological effects of intense radiation on the eyes of animals. These researches, which have extended through several years and which have been outlined previously in the ELECTRICAL WORLD, show that from the standpoint of radiation very little indication exists of any real structural damage to the eye even by intensities much greater than those ordinarily used. Since the publication of the general results of the investigation the collaborators have had an opportunity to test the effects of radiations as intense as 50,000 lux upon the human eye for a period of thirty minutes, with the result that after four or five hours the eye returned to its previous condition. Similar exposures of the eyes of rabbits and monkeys for an hour apparently produced no permanent effect. The damage done by any ordinary amount of heat, even through looking at hot bodies, is very small except in extreme cases. By "fixing" the sun for possibly one-half minute very accurately one may get an injury about one time in 2000. The need of care in shading lamps is the result of purely secondary effects due to the strain of bad lighting on the adjusting mechanism of the eye. Ultra-violet rays as found in nature have no power to produce permanent ill effects, and only in extreme instances of exposure to artificial ultra-violet radiations, as in the flash of a heavy electric arc of great power, is any temporary effect produced. In the study of the electric arc and the electric furnace in the laboratory only the most drastic kind of experimentation is likely to be injurious, and ordinary glasses are in most cases an admirable protection, as are the bulbs of incandescent lamps. With carbon, tungsten and gas-filled lamps not the slightest ill effect has been produced on the eyes of animals. The case is entirely different in frequently using the X-rays, where the lead screen is an essential adjunct.

How Faulty Illumination Injures the Eye

Dr. Walter B. Lancaster, Boston, presented a paper in which were described the various adjustments of the eye, including fixation, focusing, adaptation to intensity of illumination, and the relation of pigment decomposition to external stimuli. He stated that the eye can effect a fixation adjustment on the retina within from

0.01 mm to 0.001 mm, while the adjustment in focusing is to about 0.025 mm. Pupillary adjustments for intensity of illumination are less delicate. Unfavorable external conditions, such as glare, rapid shifts of type as in reading on moving vehicles, variations of rapid character in the intensity, etc., produce strain through their demands on mechanical and chemical adjustment, the latter being of particular interest in the advanced study of ophthalmology. The speaker suggested that the need of extremely rapid replacements of substances wasted in pigment decomposition is a more fertile cause of eye strain than pupillary enlargement and contraction. Glare in particular probably tends to cause congestion of chemical products before they can be properly carried off by the lymph, and any cause tending unduly to hasten constructive and destructive metabolism is liable to produce strain. The elements of successive contrast and of memory also enter into the problem of vision as related to fatigue.

Axial Chromatic Aberration of the Human Eye

Dr. P. G. Nutting, of the Eastman Kodak Company, Rochester, N. Y., contributed a paper describing experiments extended beyond those of Helmholtz in the study of axial chromatic aberration. The test object used was the image of the slit of a monochromatic illuminator (Fig. 1) formed by a movable lens *L* of about 20 cm focal length. At a fixed distance back of this was the observer's eye *E*. In order to fix the accommodation, there was placed immediately in front of the eye a plate of optical glass *P*, reflecting the image of a suitable object at the desired distance.

Three eyes were tested at accommodations of 25 cm, 100 cm and infinity, and the remainder at infinity only. The object serving to fix the accommodation was so chosen that the slit image appeared against a dark background, so that a barely perceptible amount of white light was mixed with that of the colored slit image. In making determinations of wave-lengths 406 and 436 a mercury arc was used as the source, and at other wave-lengths a Nernst lamp. A shift of the lens 1 cm corresponded to 0.01-mm shift in focal point at the retina, the relation of the two being roughly linear. The uncertainty on a group of five settings was not over 2 mm. Results could be reproduced to about 5 mm in the position of the lens. Relative focal differences are shown in Fig. 2, the initials of the observers being given.

All the eyes tested show more or less correction. For

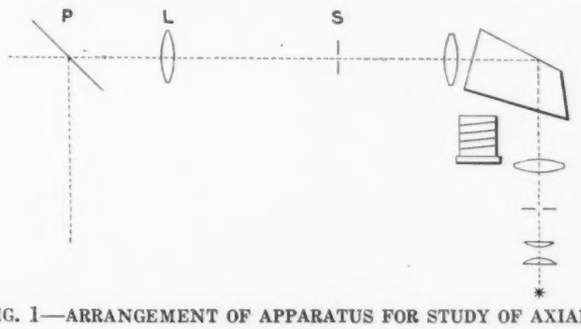


FIG. 1—ARRANGEMENT OF APPARATUS FOR STUDY OF AXIAL CHROMATIC ABERRATION

comparison, the axial error of a refracting medium of pure water is given at the top of the diagram. In the most luminous part of the spectrum, from 520 to 660, all eyes show less variation in focal length than an equivalent eye of pure water. In some eyes the correction in the central region compares favorably, in the author's opinion, with that of a good photographic or telescopic objective. Several types of correction are shown that are new to lens optics. The high order of central corrections of *L. A. J.* and *P. G. N.* are accompanied by decreased violet but normal red correction. Tests were made for residual chromatic spherical aberration (departure from Gauss condition) by placing half of a halftone screen over the test slit. The writer could detect no residual in his own eye in the region of from 500 to 650. Beyond 780 in the red and beyond 480 in the blue it is noticeable, while at 406 in the violet it amounted to fully twenty times the normal diffusion.

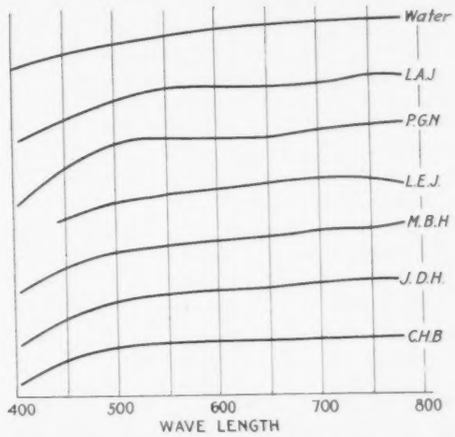


FIG. 2—RELATIVE FOCAL DIFFERENCES OF VARIOUS OBSERVERS COMPARED WITH THE AXIAL ERROR OF PURE WATER

In briefly discussing the paper, Dr. Bell stated that in the ordinary eye there is a difference in focal adjustment of from 0.5 mm to 0.6 mm between the ends of the spectrum. The curves shown are not the curves of an achromatic lens, and their explanation may have to be sought in refraction and dispersion within the eye itself. The work of the author suggests the desirability of further checking and of investigating the crystalline lens itself.

Census of Telephone and Telegraph Systems

The Bureau of the Census report on telephone, telegraph and municipal electric fire-alarm and police-patrol signaling systems in the United States will be issued soon. The report, based on returns for the calendar year 1912, was prepared under the supervision of Mr. William M. Steuart, chief statistician for manufactures.

Telephone wires in use increased from almost 13,000,000 miles in 1907 to more than 20,000,000 in 1912, or about 54 per cent. Commercial telegraph wire, including ocean cable, increased in the same period from over 1,624,000 miles to nearly 1,882,000, or 15 per cent. Statistics as to telephone calls are available only for companies with $5,000 annual income or more; these operated in 1912 about 94 per cent of the wire mileage and 84 per cent of the telephones. They reported 13,735,000,000 calls, an increase of about 32 per cent over the 10,400,000,000 reported for 1907. In the same period telegraph business—land, ocean and wireless combined—increased from approximately 103,949,000 messages to 109,663,000, or about 5½ per cent. Capitalization of the telephone companies with income of $5,000 or more increased from $758,000,000 in 1907 to $991,000,000 in 1912, or more than 30 per cent. Telegraph company capitalization decreased from $253,000,000 to $232,000,000, or 8 per cent; this was due entirely to a reduction of $23,000,000 in wireless capitalization. Excluding wireless capitalization, an increase of $2,200,000 in capitalization, or about 1 per cent, is shown. Net income of telephone companies with income of $5,000 or more increased from $41,200,000 in 1907 to $51,300,000 in 1912, or nearly 25 per cent. Net income of telegraph

companies in the same period decreased from $9,650,000 to $6,400,000, or about one-third. Telephone companies with income of $5,000 and over increased their employees from approximately 131,000 in 1907 to 183,000 in 1912, or more than 39 per cent. Telegraph employees rose from 28,000 to 38,000, an increase of nearly 36 per cent.

In 1912 the Bell system controlled nearly 75 per cent of the total wire mileage and more than 58 per cent of the total number of telephones in use. It controlled nearly 51 per cent of the public exchanges maintained by companies with annual income of $5,000 or over and handled 66 per cent of the calls over the lines of such companies. The wire mileage of the Bell system increased from 8,947,000 miles in 1907 to 15,133,000 miles in 1912, or more than 69 per cent. The wire mileage of all other systems combined increased from 4,052,000 to 5,115,000, or a little over 26 per cent. Telephones in use—exclusive of railway, governmental or private telephones not connected with public exchanges—increased from 6,118,000 in 1907 to 8,730,000 in 1912, or nearly 43 per cent. Bell and independent telephones, respectively, were 3,132,000 and 2,986,000 in 1907 and 5,087,000 and 3,643,000 in 1912, the former having increased 62 per cent and the latter 22 per cent. Bell calls increased from 6,401,000,000 in 1907 to 9,133,000,000 in 1912, or nearly 43 per cent. Calls of other companies having annual income of $5,000 or more increased from 3,999,000,000 to 4,602,000,000, or 15 per cent.

In the New England States, where the Bell interests were proportionately strongest, they controlled nearly 93 per cent of the telephones. They were relatively weakest in the West North Central States—Minnesota, Iowa, Missouri, North and South Dakota, Nebraska and Kansas—where more than two-thirds of the telephones were operated by independents. The number of independent rural telephone systems or lines increased from 22,971 in 1907 to 32,233 in 1912. Of these systems Bell interests controlled 175 in 1907 and 176 in 1912.

About one-half of the wire mileage and telephones are in New York, New Jersey, Pennsylvania, Indiana, Ohio, Illinois, Michigan and Wisconsin, which together contain about 40 per cent of the population. The greatest wire mileage in any state in 1912, 2,790,000, was reported by New York. Illinois was second with 1,689,000 miles and Pennsylvania third with 1,600,000 miles. New York had 970,000 telephones, Illinois 807,000 and Ohio 631,000.

The number of telephones per 1000 population was 91 in 1912 as compared with 72 in 1907 and 30 in 1902. Iowa had 171 telephones per 1000 population, California 168 and Nebraska 165. The smallest number, 21, was in South Carolina. The messages per capita, exclusive of those for companies having annual income of less than $5,000, increased from 65 in 1902 to 122 in 1907 and 144 in 1912. The greatest number per capita, 282, was in California. Ohio showed 265 and Michigan 240; North Carolina had 40.

Twenty-one land telegraph companies had 247,500 miles of pole line and 1,814,000 miles of wire, exclusive of wire wholly owned and operated by railroads; 222,000 miles of line and 1,296,000 miles of wire were along railway lines, and in addition 314,000 miles of wire were owned and operated by railroads. The number of messages, not including press dispatches, was 106,500,000, an increase of 5 per cent over 1907. Six United States ocean cable companies have eighty-three cable offices and 44,860 miles of cable. They handled 2,845,000 messages, an increase of 20 per cent over 1907. In addition the Western Union Telegraph Company operated 22,800 miles of cable and handled nearly 3,000,000 cable messages.

From 1907 to 1912 the number of commercial wireless telegraph companies decreased from five to four, the number of tower stations from 117 to 74, and capitalization from $32,700,000 to $9,600,000. The number of messages sent increased from 154,617 to 285,091, or 84.4 per cent. A net deficit of $53,538 was shown in 1907 and a net income of $4,738 in 1912. Employees increased from 176 to 958, or 444 per cent. The government maintains seventy-three wireless stations, a number of which are open for public business. Ships of the navy have wireless equipment for receiving messages without relay at 3000 miles and a sending radius varying from 400 miles in daytime to 1000 miles at night.

Municipal electric fire-alarm and police-patrol signaling systems increased from 1157 in 1907 to 1397 in 1912, or 20.7 per cent. Miles of single wire increased from 70,800 to 90,300, or 27.5 per cent; boxes or signaling stations from 62,500 to 81,300, or 30 per cent, and fire alarms received from 120,700 to 175,500, or more than 45 per cent.

Meeting of Rate Research Committee

The rate research committee of the National Electric Light Association met at the association headquarters in New York on March 3. Messrs. R. S. Hale, chairman, J. W. Lieb, W. J. Norton, E. W. Lloyd and R. G. Griswold were present. A draft of the report to be submitted at the San Francisco convention was drawn up and approved unanimously by the members present. Copies will be sent to the absent members and to the executive committee of the association.

In the forthcoming report the committee will probably re-assert its full confidence in the fundamental bases of rate-making which central-station companies generally have followed in the past.

Philadelphia Electric Company Leases Telephone Conduits

The Philadelphia Electric Company has leased the unused conduits of the Keystone Telephone Company for twenty-one years with the privilege of renewals. The rental will be small at the beginning, but will increase gradually until a minimum of $100,000 per annnm is reached. For the second period of fifteen years the minimum rental will be $100,000 a year, and for the third period the minimum rental will be $125,000 per annum. At the end of the second period the Philadelphia Electric Company has the option of purchasing the conduit space in use by it at a price to be fixed by arbitration, but if for any reason the option to purchase cannot be exercised, then the privilege of renewing the lease may be availed of by the electric company.

The rental will be 4 cents per duct-foot, and as there are 12,300,000 duct-feet, there is a possible maximum rental of $400,000 per annum if the requirements of the Philadelphia Electric Company shall grow so that all available space shall be utilized by the lessee. The average minimum return on the minimum basis for the first period of twenty-one years to the Keystone Telephone Company will be $87,500 per annum.

The ordinance granting the privileges of the streets to the telephone company contained a provision that the company should not sell the conduits, but there is no restriction on its ability to lease such part as it does not need for its own purposes. A portion of the conduits in the central part of the city are already leased for news service and for wires used for burglar-alarm systems. The new lease will not interfere with these leases.

Miscellaneous News Notes

Wireless Telegraph Used in Construction of Railroad.—Arrangements are being made by the Australian Minister for Home Affairs, Mr. Archibald, to equip four working parties, which are engaged in building the Trans-Australian Railway, with wireless sets so that they can keep in touch with each other and save time in the exchange of instructions.

Operation of 100,000-Volt Plant in India Begun.—On Feb. 8 the Governor of Bombay, India, closed a switch on the 100,000-volt transmision line of the Tata high-head system and energy was transmitted to Bombay for the first time from the power house, 43 miles away. This hydroelectric development was described in the ELECTRICAL WORLD of Nov. 8, 1913.

Committee on Line Construction.—The national joint committee on overhead and underground line construction will hold a meeting at the headquarters of the American Institute of Electrical Engineers, New York, on March 31. The work of revising the present energy-transmission wire-crossing specifications has been divided into sections appropriated to various sub-committees. Criticisms of any of the clauses of the present crossing specifications are invited. Mr. R. D. Coombs is secretary of the committee.

Boston Engineers Discuss Industrial Training.—At a joint meeting of the Boston sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers with the Boston Society of Civil Engineers at the Wentworth Institute, Boston, Mass., on Feb. 26, Mr. Walter C. Fish, general manager of the Lynn Works, General Electric Company, gave an address on "The Responsibility of the Manufacturer for Training of Foremen and Skilled Workmen." Other speakers were Mr. Henry S. Dennison, treasurer of the Dennison Manufacturing Company, Framingham, Mass.; Mr. William B. Hunter, director of the Fitchburg (Mass.) Industrial School, and Prof. Thomas N. Carver, of Harvard University.

Examination for Electrical Sub-Inspector.—An open competitive examination for the position of electrical sub-inspector in the office of the inspector of engineering material, United States Navy, Pittsburgh, Pa., will be held on April 7 by the United States Civil Service Commission. The salary in this position is $4.16 per day. The duties of the position cover the shop inspection and testing of all types of generators, transformers, motor generators up to 300-kw rating and other electrical machinery, and the appointee must be capable of making all calculations and deductions connected therewith. Those desiring to make application should apply at once for Form 1312, stating the title of the examination for which the form is desired, to the United States Civil Service Commission, Washington, D. C.

Electrical Engineers' Day at Kansas University.—"Electrical Engineers' Day" was celebrated at the University of Kansas, Lawrence, Kan., Feb. 25. The program of technical papers, presented largely by men outside of the university, was followed by a large banquet in the evening. At the morning session a paper on "Keeping Standards" was read by Mr. G. O. Brown, laboratorian of the Kansas City (Mo.) Electric Light Company, after which a paper on "The Relation of the Architect to the Engineer" was read by Prof. Goldwin Goldsmith, architectural engineering department of the university. At the afternoon session the following papers were presented: "Arc Lamps," by Mr. D. R. Detwiler, Westinghouse Electric & Manufacturing Company, Kansas City, Mo.; "Motor Applications," by Mr. F. R. Johnson, General Electric Company, Kansas City, Mo.; "Electrolysis," by Mr. F. H. Miller, senior student in electrical engineering; "The Construction of Telephone Cables," by Mr. F. B. Uhrig, Western Electric Company, Kansas City; "Construction Work," by Mr. W. J. Squires, Squires Electric & Construction Company, Kansas City. At the evening session the topics discussed were as follows: "The Training of Station and Substation Operators," by Mr. A. D. Stoddard, Metropolitan Street Railway Company; "The Transcontinental Telephone Line," by Mr. H. C. Louderback, Missouri & Kansas Telephone Company, and "Experiences with Alternating-Current Block Signals," by Mr. W. F. Price, Atchison, Topeka and Santa Fé Railway, Topeka.

Associations and Societies

Union Gas & Electric Company Section, N. E. L. A.—The Union Gas & Electric Company Section of the National Electric Light Association was formed at a meeting of the officials and employees of the company held at the offices in Cincinnati on Feb. 4. The following officers were elected: Chairman, Mr. F. R. Healey; vice-chairman, Mr. Fred E. Schornstein; secretary, Mr. W. A. Wadsworth; treasurer, Mr. William L. Krohme.

New York Meeting of the American Physical Society.—At the Feb. 27 meeting of the American Physical Society, held at Fayerweather Hall, Columbia University, New York, the following papers, among others, were presented: "Electrical Characteristics of X-Ray Tubes," by Messrs. J. S. Shearer and P. T. Weeks, of Cornell University, and "Response of a Silicon Detector to Short Electric Waves," by Prof. Ernest Merritt, of Cornell University.

New York Section, I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society to be held on March 11, 1915, Messrs. W. G. Grove and L. C. Porter will present a paper entitled "A Practical Study of Car-Lighting Problems," in which will be described the work done under the direction of the New York Municipal Railway Corporation for the standardization of an acceptable lighting system for railway cars. Mr. Clarence L. Law is secretary of the New York Section.

Pittsburgh Sections, I. E. S. and A. I. E. E.—At a joint meeting of the Pittsburgh sections of the Illuminating Engineering Society and the American Institute of Electrical Engineers to be held in the Engineers' Society auditorium, Oliver Building, on March 9, Dr. R. E. Meyer will read a paper relating to the manufacture of new types of tungsten lamps and Prof. H. S. Hower will deliver a lecture on the use of projector lenses in signal work. Preceding the meeting a dinner will be served at the Fort Pitt Hotel at 6 p. m.

A. I. E. E and A. E. S.—A joint meeting of the American Institute of Electrical Engineers and the New York Section of the American Electrochemical Society will be held in the auditorium of the Engineering Societies Building, New York, on Friday, March 12, at 8:15 p. m., at which the following papers will be presented: "Fixation of Atmospheric Nitrogen," by Mr. Leland L. Summers, of the A. I. E. E., and "The Cyanamide Process," by Mr. Frank B. Washburn, of the A. E. S. At the close of the technical session a smoker will be held and light refreshments served in the A. I. E. E. offices on the tenth floor of the building.

Vermont Electrical Association—The semi-annual meeting of the Vermont Electrical Association was held at Burlington on Feb. 10. The following officers were elected: President, Mr. Wilfrid Smith, of Woodstock; vice-presidents, Messrs. H. D. Larabee, of Montpelier, and E. M. Addis, of Brattleboro; secretary and treasurer, Mr. C. H. West, of Rutland; executive committee, Messrs. I. M. Frost, of Rutland; E. D. Blackwell, of Brandon; J. P. Prouty, of Newport, and R. M. McGilvray, of St. Johnsbury. "The Development of Electrical Engineering" was the subject of a paper read by Prof. W. H. Freedman to the members of the association.

Midyear Meeting of Empire State Association.—One of the midyear meetings of the Empire State Gas & Electric Association was held in the Hotel Utica, Utica, N. Y., on Feb. 26. Mr. Stuart Wilder, second vice-president of the association, presided, and about fifty people were present. The morning session was devoted to the subject of "Gas and Electric Distribution Maps and Records." The discussion was opened by Mr. A. R. Wellwood, Poughkeepsie, N. Y. Forms were presented and explained by Mr. Wellwood, Mr. G. T. Macbeth, Mount Vernon, N. Y., and Mr. Augustus T. Throop, Utica, N. Y. The delegates were entertained at lunch at the Hotel Utica by representatives of the Utica Gas & Electric Company. The afternoon session was devoted to the discussion of the new order of the Public Service Commission, Second District, requiring that uniform schedules of rates be filed. Many of the delegates wanted to have information as to the proper use of the forms of schedules prescribed by the commission. Mr. C. A. Littlefield, New York Edison Company, described the practices of companies in the First District commission's territory.

Public Service Commission News

California Commission

Upholding the decision of the commission, the California Supreme Court decided on Feb. 24 that the city of Stockton was not vested with the power to grant the Oro Electric Company a franchise to install and operate an electric plant in Stockton to compete with the Western States Gas & Electric Company. On hearing of the decision the commission stated: "The decision of the Supreme Court finally sustaining the action of the commission is naturally very gratifying. The decision means that the commission is now to have the power, through the right to grant or to deny certificates of public convenience and necessity, to carry out its broad, State-wide policies in the regulation of public utilities."

New York Commissions

Commissioner Milo R. Maltbie, of the First District commission, testifying before the legislative investigating committee in New York, was asked about a ride to Peekskill last April with Judge Ransom, of the City Court, in a commission automobile. Mr. Maltbie showed that he paid the expenses of this trip and that it was the only case in seven years of service when he had used a public automobile except on official business. He declared that he had often called for a taxicab to take him to an accident when the commission cars were in use, and paid for it out of his own pocket. "If you strike a balance," he declared, "I will get a dividend." Mr. Maltbie predicted that if the efforts of the committee put five inexperienced men in office disaster would result.

Mr. Maltbie also made a statement concerning references in the proceedings to conferences which he had with Mayor Mitchel and other city officials. He insisted that that was the only way in which he could stop action because he had only one vote, and that he had to tell city officials of matters of public interest which required their attention. "When a man is in the minority as I have been, and when he knows things are being kept from him for weeks, he must take every means for what he believes right," said Mr. Maltbie.

Mr. William M. Ivins said that sooner or later the commission will have to give up to the Board of Estimate and Apportionment of the city the rapid transit functions which really belong to the municipality. The practical situation has to be considered now, and Commissioner Maltbie was wise in his statement that delay would result from transfer of control of the construction work now. Theoretically Mr. Ivins is in favor of one commission of seven members for the entire State, three to be from up State, three from New York City, and one from any part, to act as chairman and attend to matters affecting both sections. He expressed strong opposition to a proposal to redraft the entire law. The law has been on the statute book for nearly eight years, and in large measure has been interpreted and defined. To throw it away now would be the greatest economic waste. He was in favor, however, of careful amendment and of consolidation of certain sections. Mr. Ivins uttered a warning, saying: "If we go on as we are doing now and if the Board of Estimate adopts the policy of its Bureau of Franchises, it will drive private capital away from public utilities, and we shall be confronted by the necessity of adopting State ownership or municipal ownership and providing for all our utilities out of taxation." Mr. Ivins said: "They have put so many teeth in this law and filled its blooming mouth so full it can't chew."

City Controller William A. Prendergast of New York City defended the work of the commission on subway construction. The Board of Estimate is so crowded with work that it is unable to assume added responsibilities.

President F. W. Whitridge, of the Third Avenue Railway Company, declared that the first commission appointed by Governor Hughes had made the public service commissions law ridiculous. The suceeding commissioners were courteous and sensible. The first commissioners treated their large powers like playthings. "Then the commission," he added, "got the germ of valuation, and that delusion runs down to this day." Mr. Whitridge attacked the quasi-judicial functions of the commission, saying that it was inconsistent for it to act as prosecuting attorney, grand jury and judge. While he would have a commission to regulate corporations, he would limit its expenditure to $400,000 or $500,000 a year and would give it no right to issue orders but merely to report facts to the courts, which would have discretion in making orders. "I am sorry," he continued, "to think that a commission is necessary, but in spite of the ethical revival government must exercise supervision and do something to insure publicity. If I were a commissioner I should send for the right man and tell him what I wanted and, if he refused, call in the newspapers and have a hearing. I can't believe wrong could go on if public opinion was against it."

Mayor Mitchel of New York said that he had no amendment of the law to suggest, but that the real question is one of administration. The administration of the present law has not been as effective as possible, and he established a Bureau of Franchises in the office of the corporation counsel. Theoretically it would be advisable to transfer the control of the construction work from the commission to the Board of Estimate, but practically it would be inadvisable. Mayor Mitchel favors the retention of some commission. He would not express an opinion of the present commissioners and their efficiency except so far as Commissioner Maltbie is concerned, whom he praised highly.

President George McAneny of the Board of Estimate agreed in general with the testimony of Mayor Mitchel and favored the consolidation of the engineering force of the commission with some city department. He approved the attitude of Chairman McCall of the commission in keeping the engineering force intact.

Chairman Thompson of the investigating committee read into the record an inquiry from Governor Whitman as follows: "If your committee has ascertained from its inquiry thus far conducted whether the public service commissioners of the First District have been efficient and have performed their full duty or have been inefficient and have neglected their duty either separately or as a body as shown by their official actions, I would request that you communicate to me your conclusions."

Mr. Seth Low suggested that in the interest of rapid transit the Board of Estimate should have one man in the Public Service Commission. He had opposed the appointment of Chairman McCall, but must praise him now.

President George B. Cortelyou, of the Consolidated Gas Company, favored the transfer to the commission of some of the powers intrusted to the Bureau of Franchises of the Board of Estimate. The principal desirable change in the law is its simplification. It is only fair that municipally operated utilities should be subject to as much regulation as private corporations and should be compelled to submit to the same publicity. A glaring defect is the lack of flexibility in the way in which the commission treats applications for new issues of securities. Mr. Cortelyou does not oppose supervision but fears lest supervision may become actual management. Regulation must stop short of this.

President T. P. Shonts, of the Interborough Rapid Transit Company, is not in favor of any sweeping changes at present in the commission organization. He expressed a very high opinion of the capabilities of the commission engineers, but said that it is not in human nature for them to know the practical operation of a railroad as well as the men who operate it. He denied that there had been at any time any conscious endeavor on the part of the company to disobey the commission's orders, but held that the rule of reason should be applied to violations of the orders.

President T. S. Williams, of the Brooklyn Rapid Transit Company, is willing to see construction work on the subway system transferred at once to the Board of Estimate or a new city department. The regulatory powers of the commission should be placed under a single-headed city department on account of the large interest which the city will have in the dual system. The State might retain the power to approve issues of securities and to require public reports. Without any disrespect, it is indisputable that not one of the commissioners had at the time of his appointment any administrative or technical experience to qualify him for office. With few exceptions they have been men of sincere purpose and industry, but they have had to be educated in office to the necessarily complicated problems they had to decide.

Ex-Chairman William R. Willcox thought that it should not be possible for corporations to go to the courts for writs of certiorari when ordered to improve service. Ex-Commisioners Bassett, McCarroll and Eustis also testified.

Maryland Commission

The commission has received a letter from People's Counsel Yellott, who is conducting the investigation into rates of the Chesapeake & Potomac Telephone Company, stating that he understands that the company purposes to claim a value for its easements in excess of the amount actually paid therefor. Mr. Yellott asks the commission's attitude so that he may act accordingly. In the rate case of the Consolidated Gas, Electric Light & Power Company of Baltimore the commission's general counsel, Mr. William Cabell Bruce, rendered an opinion in which he held that the easements of the company might be capitalized, although nothing had been paid therefor. Mr. Philip D. Laird, then chairman of the commission, was not in favor of allowing for easements, but the other two commission members favored a value of $5,000,000. Mr. Yellott points out that Section 34 of the public service law apparently forbids the capitalization of easements for an amount greater than cost. He points out that the United States Supreme Court held that a federal act couched in language almost identical with that of the public service law was null and void. Mr. Yellott says that in the present case it is not the function of the commission to interpret the law, that being strictly a judicial function.

New Hampshire Commission

The commission has filed a supplementary report with the Supreme Court upon the petition of the Grafton County Electric Light & Power Company for leave to acquire properties of the Lebanon and Mascoma electric companies, operating in Lebanon and Hanover. The commission finds that the proposed consolidation is not in the public interest; that the present capitalization involved is $118,000, against a proposed capitalization of $360,000; and that as the securities of the Lebanon and Mascoma companies are now held by the Mascoma Light & Power Company of Maine, the latter corporation can do anything with the Grafton company that the petitioners could accomplish. The board holds that these companies should remain independent rather than be merged with the result that local costs and revenues could not be properly determined. The commission "believes it to be undesirable that governmental sanction shall be given to the buying up of public utility properties which have accumulated a surplus out of rates paid by the public, for the purpose of merging into a new corporation and capitalizing the aggregate existing surplus." The appeal to the Supreme Court will be considered anew, the court having ordered the commission to determine whether the proposed consolidation is in the public interest, prior to deciding an appeal from previous adverse decision of the board.

Massachusetts Commission

In a decision reducing the rate of the Northampton (Mass.) Gas Light Company for gas from $1.10 to $1 per 1000 cu. ft., the Gas and Electric Light Commission discussed rate-making. There was a discrepancy of about $130,000 between the replacement value of the property as introduced by the city and the company, and approximately the same difference between present values. The commission took the ground that reproductive value affords an unsatisfactory basis of rates in view of the Massachusetts practice of restricting original issues of stock to the actual investment made by stockholders and limiting additional stock or bonds to such amounts as are reasonably necessary for the authorized purpose. The commission held that a reasonable return should be one meeting all necessary and proper corporate requirements and permitting a reasonable dividend to the stockholders, bearing in mind the manner in which the value of the property has been created, the policy pursued in the issue of securities and the intelligence, honesty and prudence of the management. This will lead to different results at different times, but is the only policy in the commission's view which has due regard to a proper reward for efficiency and affords a stimulus to managements in the recognition of the common interests of stockholders and consumers.

The board realizes that the courts have decided rate cases in which little or no evidence was offered except values of properties based on reproductive costs, but points out that the courts have not laid this down as the only test or held that the trial court or public board whose action is questioned must reach and state a definite finding as to value. Other elements are to be considered, and it is fallacious to assert broadly that the cost of reproduction is the sole controlling test of earning power, especially when the price yields all that the capital employed under the restrictions and limitations of the case has ever required. In the Northampton case the board is of the opinion that the rate made will yield enough to provide for all proper operating expenses, including depreciation and a fair return upon the value of the property which the company is actively and necessarily employing for the public convenience. The board is also influenced in its decision by the provision previously made by the company out of its earnings, by its expenditures for repairs, and by the capacity of the present plant to take care of a considerable increase in output without substantial increase in investment. The city criticised the rent of an office and appliance store by the company, but the commission considers this a reasonable operating expense, although to the extent to which the office is used for the sale of appliances the rent seems to be an appliance-marketing expense, and the board holds that only the net loss, if any, should be thus introduced as an operating charge.

Ohio Commission

In its annual report for 1914 the commission says in part:

"No state that has ever undertaken regulation through boards or commissions created for that purpose has ever contemplated dispensing with them.

"More than $50,000 of this year's expenditures was made necessary by that provision of the law which obligates the commission to make physical valuations of the property of public service corporations upon request of the Council of the municipality where the whole or major portion of such property is situated. As the law now stands, the Council is not required to disclose to the commission, or to any one else, the purposes for which such valuation is desired, and, unless the purpose is disclosed, the commission thus far has proceeded upon the theory that such valuation is to be made for rate-making purposes.

"Whatever use may be made of valuations in fixing rates for service either by the commission or by municipal authorities, it is apparent even now, when the work of appraisal of utilities is but partially completed, that great good to the utilities themselves, and therefore to the people whom they serve, is accruing and will accrue, and the commission is pleased to report that the requirements of the appraisal order were met by the utilities in a splendid spirit of cooperation.

"During the year the commission designed and promulgated, effective on Jan. 1, 1915, a uniform classification of accounts for electric utilities privately and municipally owned or operated. Much of the work done in building this system of accounts was original in character, but every principle laid down and every practice followed were subjected to the severest tests, both from the standpoint of the officers charged with a public duty in the matter of regulation and from the standpoint of the companies charged with the duty of rendering to the public adequate service at rates that would justify investments of capital in such enterprises. The companies have manifested a willingness to give the system a fair trial, and it is expected that the experience of the next few years will demonstrate its essential soundness.

"The commission believes there should be additional legislation as follows:

"Giving the commission authority to suspend or postpone the effective date of all schedules.

"Fixing a definite time for the payment of assessments levied upon railroads and utilities for the maintenance of the commission.

"Requiring railroads and public utilities to immediately notify the commission of changes in the personnel of their responsible officers.

"Authorizing the commission to order the refunding of illegal or unreasonable charges by railroads or utilities.

"Exempting the members of the commission and all of its employees from being required to attend or testify in civil actions when the matter out of which the action grew has been officially investigated by the commission or its employees."

Personal

Mr. C. E. Terrill, resident manager at Bucksport, Maine, of the Penobscot Bay Electric Company, has resigned.

Mr. J. W. Reeve, general manager of the Gainesville (Fla.) Gas & Electric Power Company, has been appointed receiver of the company by the Circuit Court.

Mr. Frank M. Morgan, who for a number of years has been superintendent of the Adirondack Electric Power Corporation, Glens Falls, N. Y., has resigned.

Mr. R. P. Benedict, formerly chief engineer of the Northampton (Mass.) Electric Lighting Company, has been appointed commercial manager of the Athol (Mass.) Gas & Electric Company.

Mr. Harley G. Hard has been appointed manager of the Boulder office of the Western Light & Power Company of Denver, Col., succeeding Mr. J. J. O'Donnell, who resigned to engage in other business.

Mr. Howard O. Sturges has been elected president of the Narragansett Electric Lighting Company of Providence, R. I., as successor to Mr. A. L. Kelly, who retired after seven years' service in that office.

Mr. Herbert L. Harries, who until quite recently was connected with the Louisville properties of H. M. Byllesby & Company, has accepted a position with the Central Hudson Gas & Electric Company at Poughkeepsie, N. Y.

Mr. Edwin A. Barrows, secretary-treasurer of the Narragansett Electric Lighting Company of Providence, R. I., will in addition fill the office of vice-president, made vacant by the promotion of Mr. H. O. Sturges to the presidency.

Mr. J. F. Wilson, who has been the superintendent of the Chatham (N. Y.) Electric Light, Heat & Power Plant for the past eleven years, has resigned and taken the position of superintendent of the light and power plant at Red Hook, N. Y.

Mr. H. J. Grey has been appointed superintendent of the plants of the Oakland Power Company at Clarkston, Mich., succeeding Mr. W. C. Clark. The Oakland Power Company was recently started by former Congressman E. Denby, of Detroit.

Mr. W. H. Taafe has been appointed chief of the division of capitalization of the New York Public Service Commission, Second District, to succeed Mr. H. C. Hopson, resigned. Mr. Taafe was formerly principal assistant in the division and has been with the commission since its establishment.

Mr. Niso Ito, of the Tokio Electric Company, is on a visit to this country to study the latest methods of manufacturing electrical equipment. Mr. Ito will spend four months in the United States and is particularly interested in the manufacture of electric lamps. His company has a lamp factory at Kawasaki with an output of about 40,000 lamps a day.

Mr. Joseph M. Prior has been appointed acting chief engineer of the Public Utilities Commission of Illinois, succeeding Mr. Robert M. Feustel, whose resignation was recently noted in these columns. Mr. Prior was formerly assistant chief engineer of the Illinois commission, coming to the commission from the engineering staff of the Chicago, Milwaukee & St. Paul Railroad at Chicago.

Mr. H. C. Hopson, who has resigned as chief of the division of capitalization of the New York Public Service Commission, Second District, to engage in business relating to public utilities, has been with the commission for six years and was in charge of financial and accounting examinations relating to capitalization, rates and reorganization. Formerly he was with the Wisconsin Tax Commission and the Interstate Commerce Commission.

Mr. C. Nesbit Duffy, who since his arrival in Manila, P. I., has evinced an active interest in all that pertains to civic welfare, was the choice of the board of directors of the Manila Merchants' Association for vice-president. Mr. Duffy, who is now vice-president and resident manager of the Manila Electric Railroad & Light Company, was formerly connected with the Milwaukee Railway & Light Company and with the accounting sections of the National Electric Light Association and the American Electric Railway Association.

Mr. H. A. Steen has been appointed electrical engineer of the New Jersey Zinc Company's electrical equipment in Franklin and Ogdensburg, N. J., including power plant, motor and lamp installations and the transmission system connecting the towns. Mr. Steen, who is a Norwegian by birth and who received his technical education at Christiania, Norway, and at Darmstadt and Karlsruhe, Germany, has been connected with the Westinghouse Electric & Manufacturing Company, the Allis-Chalmers Company and the Cutler-Hammer Manufacturing Company as designing engineer for the last fourteen years.

Mr. G. Wilbur Hubley, superintendent of the electrical department of the Louisville (Ky.) Gas & Electric Company, and formerly superintendent and chief engineer of the old Louisville Lighting Company, has resigned. Mr. Hubley was connected with the Louisville properties during the past twenty-two years, and was formerly associated with the Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa. He is a member of the American Institute of Electrical Engineers and the National Electric Light Association and a past-president of the Engineers and Architects' Club of Louisville.

Mr. Henry L. Rice, who was recently elected vice-president and manager of the Wisconsin Railway, Light & Power Company, Milwaukee, Wis., is a native of Massachusetts and was educated there. He began his career as chemist for the Milwaukee Gas Light Company and became superintendent of distribution before leaving that city eighteen years ago. From Milwaukee he went to Norfolk, Va., as superintendent of a gas company and was later made its general manager. Ten years ago Mr. Rice became general manager of the Western United Gas & Electric Company at Aurora, Ill. When he went to the Aurora company it was serving ten cities and towns. It is now serving more than fifty.

Mr. John Montgomery, contract agent of the Western Canada Power Company of Vancouver, British Columbia, has accepted the position of superintendent of the "electric shop" with the Utah Light & Traction Company of Salt Lake City, Utah. Mr. Montgomery for several years prior to 1908 was commercial agent of the Utah Light & Railway Company and resigned to accompany Mr. R. F. Hayward to the City of Mexico, where Mr. Hayward was in charge of the construction of the Necaxa hydroelectric plant, which supplies electrical energy to Mexico City. Mr. Montgomery later accompanied Mr. Hayward to Vancouver, where the later was engaged in the erection of extensive hydroelectric plants and transmission lines for the Western Canada Power Company at Stave Falls. The depression in business occasioned by the war in Europe and its effect on the British colonies have made it necessary for the Western Canada Power Company to curtail its expenses and to dispense with the services of many of its employees temporarily.

Mr. Walter Robbins, who was recently elected vice-president of the Wagner Electric Manufacturing Company of St. Louis, was born in Marquette, Mich., where he made his home until after his graduation from the University of Michigan in 1896. On leaving the University of Michigan Mr. Robbins obtained employment with the Western Electric Company in Chicago and served that company in several important positions until 1905. In the latter part of that year he entered the employ of the Wagner Electric Manufacturing Company as assistant general manager, which position he filled until his recent elevation as vice-president. Mr. Robbins has always taken a keen interest in things electrical and was one of the leading spirits in the formation of the League of Electrical Interests of St. Louis, of which he was for a time the secretary.

WALTER ROBBINS

Mr. W. S. Thomas, who has just been elected vice-president of the Wagner Electric Manufacturing Company, is also treasurer of the company. He was born at Pleasant Hill, Ill., in 1867, and graduated from the Normal School at Normal, Ill., in 1886. Owing to ill health he rested for a year after his graduation and then entered the employ of a bank in San Antonio, Tex., where he remained a year. Returning to Pleasant Hill, he purchased a grain elevator and subsequently a general-merchandise store. In 1894 he went to St. Louis and organized the Aroma Coffee & Spice Company, of which he was president and treasurer. After seven years' service he sold his interests in that company and accepted a position as general manager of D. G. Evans & Company. In November, 1907, he became assistant treasurer of the Wagner Electric Manufacturing Company and after a few months was appointed treasurer.

W. S. THOMAS

Obituary

Hiram B. Shoemaker, for twenty years superintendent of the Martinsburg (W. Va.) Power Company and one of the prominent electrical men of that section, died Feb. 23 at the age of fifty-nine years.

John P. Bodine, vice-president of the Bodine Electric Company, 564 West Randolph Street, Chicago, died Feb. 25 at the age of fifty-six years. Bright's disease, from which Mr. Bodine had been a sufferer, was the cause of death. Mr. Bodine was associated in business with his two sons.

John C. MacInnes, a leading merchant of Worcester, Mass., and for many years a director of the Worcester Electric Light Company, died suddenly at his home on Feb. 24, at the age of sixty-six. He was closely identified with the policy of new-business development which has brought the Worcester central station into special prominence during the past few years.

E. G. Bernard, president of the Bernard Electric Company of Troy, N. Y., died suddenly of an attack of heart disease on Feb. 23. Mr. Bernard, who was one of the best known electrical jobbers in the State of New York, and who for many years was one of its most prominent electrical contractors, was born in St. Louis in 1862. He went to Troy in October, 1890, and engaged in the electrical business. During the Spanish-American War he had a contract with the Navy Department for the wiring of a number of battleships and cruisers, and for years he controlled some of the best wiring contracts in the Mohawk and Hudson River valleys. Mr. Bernard was a member of the Electrical Supply Jobbers' Association and a member of the Elk and Masonic orders. He is survived by a widow and a son.

H. A. Russell, of the General Electric Company's San Francisco office, died suddenly in San Francisco on Feb. 22. Mr. Russell was born in Sacramento, Cal., April 10, 1860, and was a graduate of the University of California. He became connected with the Thomson-Houston Electric Company in San Francisco in 1890 and left that work in 1892. During the following two years he was successively associated with the Westinghouse Electric & Manufacturing Company in San Francisco and engaged in mining work in Mexico. In 1894 he returned to San Francisco and joined the staff of the General Electric Company, where he remained until his death. Until about a year ago he had for some years been manager of the apparatus sales in the San Francisco district, but more recently had devoted his entire attention to the introduction of special lines of electrical machinery. Mr. Russell was widely known on the Pacific Coast. He was a member of the Bohemian Club and of numerous other organizations.

Corporate and Financial

Springfield Railway & Light Preferred Stock Offering.—Bodell & Company, of Providence, are offering at par $750,000 of Springfield (Mo.) Railway & Light Company's 7 per cent cumulative preferred stock.

Oceanside Company to Issue Notes.—The Oceanside Electric & Gas Company has been authorized by the California Railroad Commission to issue $12,442 of promissory notes to refund other notes now outstanding.

Public Securities Company Passes Dividends.—The Public Securities Company, which was incorporated in New Jersey in 1910 to finance public utility securities, has passed the regular semi-annual preferred dividend of 3½ per cent.

Alabama Power Bond Offering.—Perry, Coffin & Burr of Boston and N. W. Harris & Company are offering at 100½, to yield 5.81 per cent, $2,000,000 Alabama Power Company first mortgage 6 per cent three-year gold bonds, due on Feb. 1, 1918.

Montreal Tramways & Power Note Offering.—Potter, Choate & Prentice of New York are offering at 99¼ and interest to yield 6.4 per cent $7,000,000 of two-year 6 per cent collateral-trust gold notes for the Montreal Tramways & Power Company, Ltd. The notes are dated April 1, 1915.

Pennsylvania Water & Power Bond Offering.—Kissell, Kinnicutt & Company of New York and Drexel & Company of Philadelphia are offering at 90½ and interest to yield over 5.7 a block of first mortgage 5 per cent sinking-fund gold bonds of the Pennsylvania Water & Power Company, due Jan. 1, 1940.

Manila Electric Dividend Reduction.—A quarterly dividend of 1½ per cent has been declared by the Manila Electric Railroad & Lighting Corporation, payable April 1 to holders of record March 18. Previous quarterly dividends were 1¾ per cent. The present dividend places the stock on a 6 per cent basis as against the former 7 per cent basis.

Western Power Plant Operation.—The stockholders of the Western Power Company have received notice that 90.7 per cent of the company's stock has been deposited under the adjustment plan, and that the plan is therefore declared operative. An additional 4.4 per cent of stock has been pledged to the plan, making in all a total of 95.1 per cent. Deposits will be received until March 15.

York Railways Annual Report.—The annual report of the York (Pa.) Railways Company, Edison Light & Power Company and York Suburban Land Company for the year ended Nov. 30, 1914, gives the following consolidated statement:

	1913	1914
Gross earnings	$767,162	$796,645
Operating expenses	$397,530	$408,142
Allowances for depreciation	16,736	16,916
Taxes	39,900	39,755
Total	$454,166	$464,813
Net earnings	$312,996	$331,832
Interest and bond discount	217,078	223,338
Net income	$95,918	$108,494

Asheville Power & Light Annual Report.—The Asheville (N. C.) Power & Light Company served 3176 customers with electrical energy and had a total output of 5,786,000 kw-hr according to the annual report for the year ended Dec. 31, 1914. The company is a subsidiary of the Carolina Power & Light Company and purchases energy from the North Carolina Electrical Power Company. Earnings for 1913 and 1914 follow:

	1914	1913
Gross earnings	$443,265	$396,527
Operating expenses and taxes	238,468	221,906
Net earnings	$204,797	$174,621
Interest	52,607	52,920
Balance	$152,190	$121,701

Electric Utility Operations in Montana.—According to returns of the Public Service Commission of Montana, included in the seventh annual report, the investment in plant and equipment as of June 30, 1914, was $73,786,519. For the year ended June 30, 1914, operating revenue amounted to $4,646,846, non-operating revenue to $865,954, and operating expenses to $1,815,115. The net revenue after deducting operating expenses was $2,831,731, and the total net income was $3,697,685. In the report of the Havre

Electric Company depreciation was not included in the operating expenses, and in the report of the Helena Light & Railway Company, electric, street-railway and gas reports were included. Reports were not available from the Bridger Light & Water Company or from the Glasgow municipal plant. Of the investment in plant and equipment $45,743,647 represented the Montana Power Company. That company showed $2,130,041 operating revenue, $800,765 non-operating revenue and $755,581 operating expenses.

Pacific Lighting Corporation Annual Report.—Notwithstanding the reduction in rates effective on July 1, 1914, electric sales of the Pacific Lighting Corporation, according to the annual report for the year ended Dec. 31, 1914, were $57,121 larger than in 1913. Betterments for the electric department aggregated $277,769. The 1914 statement is presented herewith:

Gross income		$4,443,665
Expenses		3,028,307
Gross profit		$1,415,358
Balance		
Depreciation:		
Gas department	$540,079	
Electric department	302,079	
Net profit		$573,200

North American Company's Annual Report.—The annual report of the North American Company for the year ended Dec. 31, 1914, shows the accompanying comparative statement for the years 1914 and 1913. The report also contains a statement of earnings and the assets and liabilities of the various companies in which the North American Company is interested.

	1914	1913
Interest received and accrued	$610,145	$476,695
Dividends received	1,503,801	1,814,424
Profits and compensation for services	42,377	78,623
Total	$2,156,323	$2,369,742
Salaries, legal expenses, net rentals and all other expenses of administration	$77,630	$77,514
Taxes	24,397	26,160
Interest paid and accrued	140,173	166,968
Sundry accounts written off and reserves	5,351	11,538
Total	$247,551	$282,180
Net income	$1,908,772	$2,087,562
Dividends paid and accrued during year	1,489,665	1,489,665
Balance carried to undivided profits account	$419,107	$597,897

National Carbon Annual Report.—In his annual report to the stockholders for the year ended Dec. 31, 1914, Mr. James Parmelee, the president, stated that, notwithstanding the business depression during a large part of the year, the company has been able, in view of its diversified products, to make quite a satisfactory showing. On Jan. 1, 1914, the company absorbed the allied American Every-Ready Company, and for the first time this company's earnings have been included with those of the National Carbon Company. The company's income and profit and loss statement for the year is as follows:

Net income for year after adjustment of inventory		$2,215,880.
Disposed of in the following manner:		
Dividends on preferred		372,750
Dividends on common		582,930
Depreciation (excluding monthly charges aggregating $145,589)		389,873
Reserve for bonus to employees subscribers to stock		25,000
Customers' accounts written off		19,708
Credited to profit and loss		825,619
Total		$2,215,880
Profit and loss:		
Surplus Dec. 31, 1913		$1,330,236
Surplus for the year ended Dec. 31, 1914		825,619
Revaluation and sale of property		1,750,001
Gross surplus		$3,905,856
Surplus charge, stock dividend of 50 per cent on common, paid March 20, 1914		2,750,000
Surplus Dec. 31, 1914		$1,155,856

Northern Illinois Public Service Annual Report.—In the annual report of the Public Service Company of Northern Illinois for the year ended Dec. 31, 1914, Mr. Samuel Insull, the president, stated that the operating revenue had increased $601,766 over 1913, while the operating cost had increased but $58,985. The company has electric service in 139 villages and serves 54,850 customers with electrical energy, besides doing a large gas, water and heat business. The connected load on Dec. 31, 1914, amounted to an equivalent of 2,004,960 standard 16-cp lamps, an increase of 167,330 units during the year. Earnings and expenses were as follows:

Gross earnings		$6,656,899
Operating revenue	$5,938,133	
Merchandise sales and other income	718,766	
Expenses (including taxes)		3,656,685
Operating expenses	$3,053,655	
Cost of merchandise sales and of other income	603,030	
Earnings for the fiscal year 1914		$3,000,214
Charges against earnings:		
Interest on bonds and notes		1,461,462
Available for dividends		$1,538,752
Dividends paid:		
Preferred stock		455,280
Common stock		503,125
Surplus for 1914		$580,347
Appropriated out of surplus earnings for the year to establish an amortization and depreciation reserve		400,000
Balance carried to surplus		$180,347

American Gas Annual Report.—In his annual report to the stockholders of the American Gas Company, Mr. Morris W. Stroud, president of the company, stated that since the beginning of 1915 the board of directors has decided not to sell the remaining $1,000,000 of three-year 6 per cent secured gold notes, the first million of which was sold last October. It was decided to keep the notes in the treasury and to make an allotment of 20 per cent of stock. The stock allotment will retire all floating debt of the company and put it in funds for the improvements and extension requirements for the year. These requirements include the completion of the large installations at Chester, Rockford and Hubbell's Falls. The earnings statement of the company and its affiliated companies follows:

		1914	1913
Gross earnings, affiliated companies		$3,764,837	$3,410,976
Operating expenses, affiliated companies		1,967,704	1,789,407
Balance		$1,797,133	$1,621,569
Fixed charges, affiliated companies		1,007,894	901,071
Balance		$789,239	$720,498
Depreciation charges, affiliated companies		173,421	149,005
Balance		$615,818	$571,493
Sundry income items		271,044	248,286
Total revenue, American Gas Company		$886,862	$819,779
Expenses:			
Bond interest	$142,623		
Note interest	2,378		
Interest on loans	50,228		
Expenses and taxes	139,349		
		334,578	314,268
Surplus		$552,284	$505,511
Dividends		374,882	311,596
Net surplus		$177,402	$193,915

Standards for Public Utility Investments.—In a recent address before the San Francisco Chapter of the American Institute of Bankers Mr. Paul A. Sinsheimer, bond expert of the Railroad Commission of California, presented six standards to be followed or investigated by those investing in public utility securities—physical, legal, financial, commercial, territorial and managerial. The physical standard is the plant. The legal standard presents the problem of franchise, mortgage, agreement, contract, and taxation and investment status. In any mortgage attention should be directed to the percentage of additions and betterments against which bonds may be issued and to the earnings required as prerequisite to the issue of escrow bonds. The financial aspect of public utility securities was divided into valuation, earnings and expenditures. The subject of valuation, while the most important economically, is greatly misunderstood. The meaning of the phrase "fair value," as laid down by the United States Supreme Court in 1898 in the case of Smythe vs. Ames, is still debatable by rate-making bodies. The effort in finding value has been and must be to determine reasonable cost. Under the heading "commercial standard" come market, value of security as collateral for loans, convertibility and present price. The territorial standard relates to territory served, condition of monopoly or competition, diversity, growth and possibilities of territory. The last standard, managerial, relates primarily to type, efficiency and personnel. The public policy, public

relationship and general business of the management are weighed. In closing, Mr. Sinsheimer drew attention to three lines of endeavor of the commission: First, proper provision for supplementary financing; second, insistence upon a truthful balance sheet, and, third, elimination of illegitimate profits.

Georgia Railway & Power Annual Report.—The annual report of the Georgia Railway & Power Company for the year ended Dec. 31, 1914, states that the electrical output was much smaller than it would have been had the storage reservoir at Mathis, on the Tallulah River, for use in connection with the Tallulah Falls hydroelectric station, been completed. Until the reservoir is completed the station must depend on the available flow of the river. With the exception of a small amount of work on the storage reservoir, the entire Tallulah Falls hydroelectric development is completed. During the year $501,522 was expended for construction work, including $55,410 for the Atlanta Gas Light Company, a subsidiary. The consolidated statement follows:

Operating revenues		$6,341,183
Operating expenses		3,323,726
Net operating revenue		$3,017,457
Taxes		434,347
Balance		$2,583,110
Other income		166,466
Gross income		$2,749,576
Deductions:		
Interest on bonds	$1,236,527	
Interest on notes	60,111	
Extinguishment of discount	8,466	
		1,305,104
Balance		$1,444,472
Rental dividends		801,168
Net income		$643,304
Sinking fund contributions		102,933
Balance		$540,371

Kansas City Reorganization Plan Disapproved.—In the United States court at Kansas City, Mo., Judge William C. Hook listened, Feb. 26, to the arguments of attorneys, representing stockholders, bondholders and other creditors, in support of their suggestions for the reorganization of the street railways of Kansas City. The court declined to approve the plan, and the session adjourned with the interested parties at wider variance than ever but with a general confidence that some method of reorganization could be devised that would avoid foreclosure. The proposed plan depended chiefly upon a combination of the electric-light company with the street-railway company so that the credit of the former could be available as an unencumbered equity in case of later emergencies. The judge insisted that he would under no circumstances consent to any arrangement resembling the operation of a holding company; that the electric-light company and the street railway must be kept separate. The court pointed out that the railway company owned power houses, while the light company had none. The city, interested in only the street railway property under the franchise, would, if the suggested plan were adopted, want to see as large a revenue for energy as possible, while the light company would want to get its energy as cheaply as possible. If the city should wish to sell energy to other concerns besides the light company, it would soon be competing with itself. The judge also mentioned the unsettled status of the regulation of rates for energy sold at the building walls of power houses. The power company in such cases, he said, was not serving the public; it was not furnishing light nor hauling passengers. The attorneys suggested that the regulation of such rates could be attained through the regulation of the rates of the companies which bought energy at the building walls and served the public. The court intimated that heretofore and in the proposed plan the bond and stock and note holders were seeking to take the settlement of the affairs of the companies out of the court's hands and to protect only their own interests. The judge said that, under the franchise granted, the Kansas City Railways Company must start out free of debt, and that many obligations must be taken care of, the creditors in which had not been heard from. He said the court would see that all interests and creditors were protected, as well as the bondholders and noteholders. After the rejection of the plan, attorneys said another effort would be made to devise a suggestion to present to the court. Mayor Jost of Kansas City addressed the court after the opinion was delivered, insisting on his previous position and on the strict terms of the franchise. The judge asked explicitly if the Mayor would insist on the bonds running the full term of the franchise, and the answer was positive that he would so insist. Both the judge and the Mayor expressed their opinions that no better franchise than that granted was obtainable from Kansas City, and the Mayor added that no franchise would be considered while he was the city's executive. According to the plan of reorganization of the Kansas City Railway & Light Company, the stockholders' interest shall remain as it exists without assessment. The secured indebtedness of $28,700,000 and the capital requirements are to be provided for as follows: (a) New twenty-five-year 5 per cent first mortgage bonds upon the street-railway property, to be used exclusively for canceling old bonds and providing necessary money for future additions; (b) new twenty-five-year 6 per cent first lien collateral mortgage notes of the company, to be used for the sole purpose of taking up the debts due, the electric-light company to be left without a lien upon its physical property; (c) new twenty-five-year 6 per cent second lien railway and light notes to raise the $3,400,000 necessary for immediate requirements. To accomplish this result it is proposed that the $55,000 Corrigan Consolidated Street Railway Company's 5 per cent bonds and the $250,000 East Side Electric Railway Company's 5 per cent bonds and the notes to the Kansas City Bank aggregating $680,000 be paid in cash; the Metropolitan consols be exchanged at 107 into new street railway bonds or at par into three-year 5½ per cent notes of the railway and light company; the $10,200,000 railway and light old refunding 5 per cent bonds be exchanged for the new street-railway bonds at 107; the $2,000,000 Central Electric Railway Company's bonds be exchanged for the new railway and light first lien notes at 105, and the $5,478,000 matured railway and light 6 per cent notes be exchanged for the new railway and light first lien notes at 105. It was also proposed that the $2,600,000 Kansas City Elevated and the $500,000 Kansas City & Westport Belt bonds, due respectively in 1922 and 1926, shall rest upon the property without any assumption of liability thereon, but $3,410,000 of new street-railway bonds shall be set aside for acquisition of the property securing them. Arrangement has been perfected whereby $4,000,000 will be taken in second lien bonds at 85, and under this arrangement there is reserved to each stockholder the option to take his pro rata share at the same price. The readjustment managers named by the bondholders', noteholders' and stockholders' committees respectively are Kuhn, Loeb & Company and Blair & Company, of New York, and Lee, Higginson & Company, of Boston.

Manufacturing and Industrial

The National Pole Company, 741 Peyton Building, Spokane, Wash., has recently moved from 1201 National Building, Spokane.

The Elux Miniature Lamp Division of the National Lamp Works of the General Electric Company has recently moved to 16 East Fortieth Street, New York.

Theobald M. Quinn, 343 Cutler Building, Rochester, N. Y., has taken over the business of Morrison & Quinn, Inc., engineering contractors, 311 Cutler Building, Rochester, N. Y.

Ball Bearings from Germany.—The Hess-Bright Manufacturing Company, Front Street and Erie Avenue, Philadelphia, Pa., reports that it is receiving large quantities of ball bearings from its Berlin (Germany) works, the total amount received since Sept. 15 last being 375,000 bearings of assorted sizes. One large shipment is now en route.

The X-Ray Tube Company, Inc., 100 Fifth Avenue, New York, is a concern which was recently formed to make X-ray tubes and chemical glassware. Mr. O. A. Roensch is president of the company, Mr. M. F. Davis treasurer and Mr. A. H. Jackson secretary. Mr. Roensch and Mr. Davis were formerly partners and owners of the Baker X-Ray Company of 118 East Eighty-seventh Street, New York.

Salesmen's Conference.—Over 200 salesmen of the National Carbon Company, of Cleveland, Ohio, were present at a recent conference which was held in the company's offices and which lasted two days.

Consular Recommendations on South American Trade.—The Bureau of Foreign and Domestic Commerce of the Department of Commerce has recently issued a twenty-nine-page bulletin designated as Miscellaneous Series No. 20 and entitled "Consular Recommendations on South American Trade."

The Kerr Turbine Company, Wellsville, N. Y., has appointed Mr. J. S. Huey as its district sales agent for Louisiana and southern Mississippi. Mr. Huey was formerly connected with the Allis-Chalmers Company and Woodward Wight & Company. His headquarters will be at 418 Hibernia Bank Building, New Orleans, La.

L. B. Marks and J. E. Woodwell, consulting engineers, 103 Park Avenue, New York City, announce that they will dissolve partnership on May 1. Mr. Woodwell will locate his offices at 8 West Fortieth Street, where he will continue the general practice of consulting engineering, and Mr. Marks will retain his offices at 103 Park Avenue and will specialize as heretofore in illuminating engineering.

Manufacturer of Vacuum Cleaners Enlarges Plant.—The Sterling Machine & Stamping Company, Wellington, Ohio, has recently let contracts for another factory building, which is to be erected at once. When the building is completed the company will have three large buildings for the manufacture of vacuum cleaners. The "Brilliant" vacuum cleaner, which this company is making, was described in the ELECTRICAL WORLD June 7, 1914.

The Usona Manufacturing Company has recently been granted charters under the laws of New York and Ohio. The company is manufacturing flashlamp cases, batteries, lamps and battery lanterns. Its Eastern office is at No. 1 Hudson Street, New York, and its Western office at No. 1012 Monroe Street, Toledo, Ohio. The incorporators of the New York company are Messrs. G. G. Beers, F. Stout and W. Carell, of New York City.

The Boller Insulated Wire Company, 122 Curtis Street, Chicago, Ill., which was recently organized, is engaged in the manufacture of enameled silk-covered and cotton-covered magnet wire ranging in size from No. 16 to No. 40 B. & S. gage. It is also making various types of coil windings. The officers of the company are: President, Mr. P. Boller; vice-president and sales manager, Mr. L. G. Ross; secretary, Mr. A. P. Boller; treasurer, Mr. W. M. Boller. The company has sales agencies in New York and other cities.

Rubber-Covered Wire Twenty Years After.—Pieces of the Okonite rubber-covered wire which formed part of the original lighting system installed in the Holy Name Cathedral, Chicago, twenty years ago, were recently removed and tested by the city department of electrical inspection. The insulation withstood an immersion test of 15,000 volts and showed a unit strength of 526 lb. per sq. in. The braid and insulation appeared in good condition and successfully withstood the bending and other tests required of present-day insulations.

The Best Electric Company, Pittsburgh, Pa., has appointed Mr. Fred W. Godfrey to look after its sales in New York, eastern Pennsylvania, New Jersey, Delaware, Maryland and Virginia, and Mr. J. O. Corbett to look after its sales in western Pennsylvania, Ohio, West Virginia, Kentucky, Indiana and Tennessee. Mr. Godfrey was formerly connected with Nagel & Company, of Toledo, Ohio, and with the Bryan-Marsh Company, and is well known in the electrical business throughout the States of Ohio and Indiana. Mr. Corbett was formerly connected with the Economy Fuse & Manufacturing Company. Both Mr. Godfrey and Mr. Corbett are statesmen-at-large in the Jovian Order.

Order for Electrical Apparatus.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently received orders for the following equipment: The Interboro Rapid Transit Company, New York, six field-control motor equipments and automatic battery-control apparatus, which will be used in the Belmont-Steinway tunnel; the Oakland, Antioch & Eastern Railways Company, several equipments of quadruple 100-hp motors and control; the Los Angeles & San Diego Beach Railways Company, several motors and automatic-control apparatus; the Reading Transit Company, Reading, Pa., three 185-kva outdoor transformers; the Arkansas Valley Railway, Light & Power Company, Pueblo, Col., three 150-kva outdoor transformers; the Tennessee Power Company, Chattanooga, Tenn., one 200-kva transformer; the Chattanooga Railway & Light Company, Chattanooga, Tenn., one 300-kva transformer; the Hershey Transit Company, Hershey, Pa., several portable railway equipments; the Public Service Railway Corporation, Newark, N. J., thirty-five quadruple equipments and control apparatus.

Sanguine of Business Outlook in Southwest.—In commenting on general business conditions in Texas and the Southwest, Mr. Charles W. Hobson, president and general manager of the Southwest General Electric Company, Dallas, Tex., formerly the Hobson Electric Company, has expressed himself in the following optimistic terms: "Business in the Southwest is gradually getting better; in fact, in some sections it is good. I think the Southern people hurt themselves seriously by talking too much. Conditions were never so bad as was generally believed. Texas has raised a good cotton crop and has received a better price than the average for it; that is, better than the average price paid during the last ten or twelve years. The cotton merchants of Dallas have paid out $10,000,000 more for cotton since last September than they did during the same period a year ago. While cotton is nominally quoted at a lower price than a year ago, the grades are very fine and cotton brings from 0.5 cent to 0.75 cent per lb. more than the nominal quotation. Twelve months ago, however, the grades were poor and the actual sales were 10 per cent to 25 per cent less than nominal quotations. Texas has been fortunate in having a good grain crop and foodstuffs of all kinds. Practically all surplus horses have been sold at fancy prices to foreign governments, and cattle are also bringing good prices. Fundamentally Texas is perfectly sound, and it should be prosperous. I feel confident that we have passed through the worst and that business will steadily improve. My prediction is that within twelve months from now we shall be in an unusually prosperous condition. A few months ago people generally believed that there would be no market for cotton and that money would be very scarce. The facts are exactly to the contrary, not only in Texas but throughout the South generally. The much-talked-of $135,000,000 cotton pool was dissolved on Feb. 1, having made loans to the extent of only $28,000, and all of this in one locality in Alabama. The Texas banks have large reserves and are in a position to take care of all legitimate demands for money from business people. A widespread interest is being taken here in having Texas raise more foodstuff, and the present year will undoubtedly show a very large return from crops of this character. The business of the Southwest General Electric Company has suffered to some extent, but our showing for the year 1914 was very satisfactory and I am confident that it will be equally good this year."

NEW YORK METAL MARKET PRICES

	Feb. 28 Selling Prices Bid	Feb. 28 Selling Prices Asked	Mar. 2 Selling Prices Bid	Mar. 2 Selling Prices Asked
Copper	£ s d		£ s d	
London, standard spot*	64 15 0		64 2 6	
Prime Lake	14.62½	to 14.87½	14.62½	to 14.75
Electrolytic	14.55	to 14.65	14.50	to 14.60
Casting	14.10	to 14.20	14.00	to 14.25
Copper wire base	15.87½		15.87½	
Lead	3.85		3.90	
Nickel	40.00	to 45.00	42,00	to 45.00
Sheet zinc, f.o.b. smelter	12.00		13.00	
Spelter, spot	9.50†		10.75†	
Straits tin	39.00		40.50	
Aluminum, 98 to 99 per cent	19.00	to 19.50	19.00	to 19.25

*OLD METALS

Heavy copper and wire	12.50	13.00
Brass, heavy	8.75	9.00
Brass, light	7.75	7.75
Lead, heavy	3.55	3.60
Zinc, scrap	6.00	7.37½

COPPER EXPORTS

Exports of copper in form of pigs, ingots, bars, plates and scrap for week ended Feb. 20, 1915.....13,285,854 lb.

*From daily transactions on the New York Metal Exchange.
†Nominal.

New Incorporations

The Cabot Light & Power Company, of Cabot, Ark., has been organized to build an electric-lighting plant in Cabot. The officers are: M. Young, president; D. Jenkins, vice-president, and J. H. Hagan, secretary.

The Jefferson County Electric Company, of Louisville, Ky., has been incorporated with a capital stock of $5,000. The officers are: Hoke Smith, president; John F. Boyson, vice-president, and Joseph A. Jokoby, secretary and treasurer.

The Missouri & Southeastern Utilities Company, of Blytheville, Ark., has been incorporated with a capital stock of $450,000 for the purpose of building electric and gas generating plants. The officers are: W. Hollipeter, president; A. G. Little, vice-president, and P. E. Cooley, secretary.

New Industrial Companies

The V. & D. Electric Company, of Franklin, Ohio, has been incorporated with a capital stock of $10,000 to deal in electrical specialties of all kinds. The incorporators are John Van Horne, T. C. Duboise and others.

The Sohm Electric Company, of Chicago, Ill., has been incorporated by Fremont Arnfield, Warren Pease and Luther P. Swanstrom. The company is capitalized at $50,000 and intends to deal in electrical devices and equipment.

The Hobrecht Company, of Sacramento, Cal., has been incorporated with a capital stock of $25,000 by J. C. Hobrecht, Lillie M. and P. J. Hobrecht and G. S. Pearce. The company intends to conduct a general electrical supply business in Sacramento.

The Universal Electrical Equipment Company, of Dayton, Ohio, has been organized with a capital stock of $50,000 by R. H. Croninger, Carl F. Brockway and others. The company purposes to establish a plant to manufacture a variety of electrical devices.

The American Glass Specialty Company, of Warren, Ohio, has been incorporated by Harvey and J. F. Quackenbush, Henry C. Weber, Frank H. Hoffstetter and Clyde B. Little. The company is capitalized at $10,000 and proposes to manufacture incandescent lamps.

The Nouveau Lamp Company, of Lincoln, Cal., has been organized for the purpose of manufacturing ornamental lamps of all kinds, electroliers, etc. R. B. Keeler is president and P. B. Hongelli vice-president. The factory and sales department will be in Lincoln.

The Usona Manufacturing Company, of New York, N. Y., has been incorporated with a capital stock of $10,000 to manufacture and deal in mercantile, metal specialties and electrical equipment. The incorporators are W. F. Carell, G. G. Beers and F. Stout, of Plainfield, N. J.

George E. Ryan, of New York, N. Y., has been granted a charter, with a capital stock of $5,000, for the purpose of doing a general electrical contracting business. The incorporators are George E. Ryan, Robert A. Jackson and Frank E. Holahan, 501 Tremont Avenue, New York.

J. Nolte, Incorporated, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $5,000 to conduct a contracting electrical-engineering business and deal in supplies. The incorporators are Otto R. Berger, Marie D. Kaiser and Julius Nolte, 299 Putnam Avenue, Brooklyn, N. Y.

The Transport Tractor Company, of Queens, N. Y., has been incorporated with a capital stock of $100,000 to manufacture motor vehicles, engineering appliances, etc. The incorporators are Alexander Moffatt, 11 Cedar Court, Flushing; Frederick B. Stimson and Frederick J. Stimson, 109 East Seventy-first Street, New York, N. Y.

Industrial Research, of New York, N. Y., has been chartered with a capital stock of $10,000 by Lloyd H. Reed, E. C. Gossman and C. L. Hepburn, 144 East Twenty-second Street, New York. The company proposes to furnish expert service and advice in mechanical engineering, chemical, electrical and scientific problems.

Trade Publications

Direct-Current Motors.—Bulletin No. 125 prepared by the Robbins & Myers Company, Springfield, Ohio, describes and illustrates its type "C" direct-current motor.

Portable Lamp.—The Leindorf Electric Light Company, 220 West Forty-second Street, New York, has prepared a booklet which describes its portable electric lamp.

Underfeed Stoker.—The Combustion Engineering Corporation, New York, has just issued Bulletin E-2, which describes and illustrates its type "E" underfeed stoker.

Electric Lantern.—The Beacon Miniature Electric Company, 118 Duane Street, New York, has prepared a leaflet which contains information on its "Friar" electric lantern.

Washer with Inverted Drive.—The Haag Brothers Company, Peoria, Ill., has published a folder which contains information on an electrically operated washer with inverted drive.

Vacuum Cleaner.—The Doty Manufacturing Company, Dayton, Ohio, has prepared a folder which describes and illustrates its light-weight electrically operated vacuum cleaner.

Miniature-Lamp Signs.—The second edition of Catalog No. 7, recently issued by Harvey Deschere & Company, 1501 Garden Street, Hoboken, N. J., contains information on its "Argus" signs.

Long-Distance Recording System.—Bulletin 192, recently published by the Bristol Company, Waterbury, Conn., describes and illustrates its long-distance electric transmitting and recording system.

Electric Fan.—The Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York, are sending out a folder which describes several of its electrically operated fans.

Glassware for Nitrogen-Filled Lamps.—Decorative glassware for high-efficiency incandescent lamps is described in a leaflet issued by the Lensed Electric Shade Company, 100 Warren Street, New York.

Electric Incubators and Hovers.—The Lo-Glo Electric Incubator Company, 76 Greenwich Street, New York, has prepared an illustrated catalog which describes its electrically heated incubators and hovers.

Miniature Lamps.—H. W. McCandless & Company, of the Westinghouse Lamp Company, 67 Park Place, New York, have issued a catalog which lists and illustrates various types of miniature tungsten lamps.

Motor Applications.—The Mechanical Appliance Company, Milwaukee, Wis., has issued an attractively illustrated forty-eight-page catalog which shows a number of different kinds of machines operated by Watson motors.

Direct-Current Automatic Motor Starters.—The Allen-Bradley Company, 495 Clinton Street, Milwaukee, Wis., is sending out Bulletin B-7, which contains information on its type Z automatic starters for direct-current motors.

Sockets.—The Weber Electric Company, Schenectady, N. Y., for which Henry D. Sears, 131 State Street, Boston, Mass., is general sales agent, has prepared a booklet which contains information on various types of its interchangeable sockets.

Water-Softening Apparatus.—The Harrison Safety Boiler Works, Seventeenth Street and Allegheny Avenue, Philadelphia, Pa., is sending out a bulletin designated as Engineering Leaflet No. 17, which contains information on apparatus for softening hard water.

Large-Sized Diesel Engine.—A bulletin just issued by the Busch-Sulzer Brothers-Diesel Engine Company, St. Louis, Mo., contains information on its type B vertical, four-cylinder, single-acting, four-stroke-cycle, inclosed-crank-case, medium-speed Diesel engine.

Compressed-Air and Vacuum-Cleaning Apparatus.—The Blaisdell Machinery Company, Bradford, Pa., has just issued its latest general catalog which contains information on various types of its small machines. Many kinds of air compressors and vacuum cleaners are described in this catalog, which is profusely illustrated.

Construction News

New England

AUGUSTA, MAINE.—The City Council has accepted the proposal of the Central Maine Pwr. Co., of Augusta, to replace the present arc lamps with 600-cp nitrogen-filled incandescent lamps and the 60-cp incandescent lamps with lamps of 250 cp.

EAST BELFAST, MAINE.—Plans are complete for the development of 600 additional hp by the Penobscot Bay El. Co. at the Sherman lower mill site in East Belfast, on which work will begin as soon as the weather will permit. The plans include the construction of a small concrete and brick generating station and dam above the existing plant of the company at tidewater.

BOSTON, MASS.—The stockholders of the Edison El. Illg. Co. of Boston have voted to authorize the directors to petition the Massachusetts Gas & Electric Light Commissioners for authority to issue 20,840 additional shares of capital stock, the proceeds to be used for extensions to system.

Middle Atlantic

ANGOLA, N. Y.—The Public Service Commission has granted the Niagara & Erie Pwr. Co., Marine National Bank Building, Buffalo, permission to erect electric transmission and distribution lines in the village of Angola.

BROOKLYN, N. Y.—The contract for electrical equipment in new Public School 50, borough of Brooklyn, has been awarded to the Jandous El. Equip. Co., 109 West Thirty-first Street, New York, at $10,253.

BROOKLYN, N. Y.—Bids will be received by George W. Wingate, president public recreation commission, Municipal Building, New York, N. Y., until March 11 for furnishing and installing the electrical work and gas piping and all work incidental thereto required in connection with the construction and completion of the proposed Betsey Head memorial playground and recreation center, situated in Brownsville, borough of Brooklyn. Blank forms of proposals and further information can be obtained on application to the above office.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until March 15 as follows: For moving-picture booth, alterations, repairs, etc., and electric work at Public School 5, Tillary, Bridge and Lawrence Streets; also for motion-picture booth, alterations, repairs, etc., and electric work at Public School 158, Belmont Avenue, Ashford and Warwick Streets, borough of Brooklyn. Blank forms, plans and specifications may be obtained at the above office and also at branch office, 131 Livingston Street, Brooklyn.

CENTRAL ISLIP, N. Y.—The Town Board of Islip has granted the petition of the taxpayers of Central Islip to establish a lighting district for this village.

MASSENA, N. Y.—The Public Service Commission has approved the franchises of the St. Lawrence Transmission Co. of Massena to extend its transmission lines from Norfolk to Hannawa Falls, there to connect with the line of the Northern Pwr. Co., and from Massena north to the Canadian border, where connection is made with the lines of the Cedar Rapids Transmission Co. of Canada.

MINETTO, N. Y.—The Public Service Commission has approved a plan for utilizing a large water-power at Minetto, owned by the Columbia Mills and to be leased to the Niagara, Lockport & Ontario Pwr. Co. of Buffalo, for use on its Syracuse and nearby lines, through the organization of a new company to develop the power. The stock of the new company, known as the Northern New York Pwr. Corpn., is to be taken by the Columbia Mills Co. in part payment for its power. The Northern New York Pwr. Corpn. is authorized to issue $900,000 in bonds, to be sold at not less than 97. Of the proceeds $350,000 is to be paid to the Columbia Mills for its water rights, property, etc., and $455,000 for the completion of the hydroelectric developvelopment. The corporation is also authorized to issue $500,000 in capital stock to be turned over to the Columbia Mills Co. in payment of balance on the property transferred.

NEW YORK, N. Y.—Robert Adamson, fire commissioner, has asked the Board of Aldermen for $1,000,000 for the reconstruction of the fire-alarm system in the borough of Manhattan.

NEW YORK, N. Y.—The contract for electrical equipment in new Public School 91, borough of Queens, has been awarded to the Jandous El. Equip. Co., 109 West Thirty-first Street, New York, at $9,268.

NEW YORK, N. Y.—Bids will be received by J. T. Fetherston, commissioner of street cleaning, Municipal Building, New York, until March 8 for furnishing 12 tractors. Blank forms and further information may be obtained at the office of the Department of Street Cleaning, Municipal Building, New York.

RIVERHEAD, N. Y.—The Riverhead El. Lt. Co. will soon install one 19-in. by 20-in. Skinner universal engine directly connected to a 140-kw, two-phase, 60-cycle, 2300-volt generator. F. Carl Hallett is manager.

WEST WINFIELD, N. Y.—Preparations are being made by the West Winfield El. Co. for the construction of an electric-light plant. The equipment of the proposed plant will consist of a 50-hp Foos vertical gas engine, 30-kva Westinghouse alternating-current engine, with switchboard complete, and 15 Westinghouse transformers. The pole line will require 100 poles and 15 miles of wire. Westinghouse meters will be used. The street-lighting system will consist of 45 60-watt nitrogen lamps. The work will be done by the company. F. B. Mead, of Stamford, is engineer in charge.

ALLENTOWN, PA.—The contract for electrical work in the new High School building has been awarded to the Watson-Flagg Engineering Co., 27 Thames Street, New York, N. Y., for $37,580, and for heating, power and ventilating plant to J. H. Cooney & Co., of Harisburg, Pa., at $58,787.

GLEN RIDDLE, PA.—The motive power of the manufacturing plant of the estate of Daniel Lee is being changed from steam to electricity. The contract for equipment has been placed with the Western El. Co., and includes a steam engine, one 100-kw direct-current generator with switchboard, etc. W. E. S. Dyer is engineer in charge.

McCONNELLSBURG, PA.—The McConnellsburg water plant, it is reported, has ben acquired by a syndicate headed by E. R. Shollenberger and W. J. Stokes. The former is manager of the Hamburg Gas & El. Co., which furnishes electricity and gas in Hamburg, Shoemakersville, Mohrsville, Leesport, Centerport, and other towns in that vicinity.

PHILADELPHIA, PA.—Mayor Blankenburg has submitted to the Councils a draft of an ordinance providing for the removal of all overhead electric wires on all streets and alleys in the center of the city between Vine and South Streets and the Delaware and Schuylkill Rivers, on or before Jan. 1, 1917.

PHILADELPHIA, PA.—Bids will be received by M. L. Cooke, director department of public works, City Hall, Philadelphia, Pa., until March 16 for improvement of the Parkway from Nineteenth Street to Twenty-second Street, including grading, asphalt paving, block paving, sewers, water pipe and 10,200 linear ft. of electrical conduits, etc. Specifications and blank forms on which bids must be made can be obtained upon application at the office of the Bureau of Highways, Room 232, City Hall, Philadelphia.

STROUDSBURG, PA.—Plans are being considered by the Frisbie Lumber Co., of Stroudsburg, for a large addition to its power plant. The proposed improvemnts will include the erection of a power station, the installation of a large electric generator and the construction of a brick conduit, 6 ft. in diameter and about 250 ft. long.

PLAINFIELD, N. J.—Bids will be received at the office of the supervising architect, Treasury Department, until April 2 for construction, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Plainfield, N. J. Drawings and specifications may be obtained at the above office or from the custodian of site at Plainfield. O. Wenderoth is supervising architect.

BALTIMORE, MD.—James Stewart & Co., Westminster Building, Chicago, Ill., it is reported, are receiving bids on electrical equipment and other machinery (costing about $150,000) for a grain elevator at Baltimore, for the Western Maryland Railroad.

BALTIMORE, MD.—Steps have been taken by the Fifteenth District Improvement Association to secure the installation of electric lamps along certain avenues in that district. It is proposed to bring the matter to the attention of the County Commissioners.

GATE CITY, VA.—E. H. Hoge, of Gate City, it is reported is contemplating the installation of an electric-lighting plant.

STUART, VA.—The installation of an electric-lighting plant in Stuart is reported to be under consideration. I. C. DeHat, of Woolwine, is said to be interested in the project.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing agent of the Post Office Department, Washington, D. C., until April 7, for stationery, etc.; computing, baling, addressing, numbering, canceling, opening, adding and perforating machines, time recorders, leather belting; electric supplies (motors, carbons and fuses), castings, oils and chemicals, and motor-vehicle supplies, as may be ordered for the use of the Postal Service from time to time during the fiscal year beginning July 1, 1915. Blanks for proposals with specifications will be furnished upon application to the purchasing agent. A. S. Burleson is Postmaster-General.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 9, for furnishing at the various navy yards and naval stations supplies as follows: Newport, R. I., Schedule 7947—20,000 ft. electric cable. Brooklyn, N. Y., Schedule 7940—800 Leyden jars. Washington, D. C., Schedule 7934—one 50-hp induction motor; Schedule 7946—2000 ft. flexible copper tubing. Bids will be received at the same place until March 16 as follows: Brooklyn, N. Y., Schedule 7953—10½-in. portable electric drills. Philadelphia, Pa., Schedule 7977—miscellaneous electric cable. Newport, R. I., Schedule 7978—two overhead trolley hoists. Norfolk, Va., Schedule 7979—three portable geared pneumatic hoists; Schedule 7968—miscellaneous steel boiler rivets; Schedule 7969—miscellaneous hard and soft sheet copper. Brooklyn, N .Y., Boston, Mass., and Charleston, S. C., Schedule 7969—cold-rolled sheet copper. Brooklyn, N. Y., and Philadelphia, Pa., Schedule 7970—miscellaneous copper tubing and miscellaneous composition unions. Bids will also be received until March 30 for the following supplies: Mare Island, Cal., Schedule 7930—miscellaneous water-tight annunciators, miscellaneous 12-in. water-tight general alarm gongs, one electric whistle outfit, miscellaneous thermostats, one water-tight rudder angle transmitter; Schedule 7932—four steam turbine-driven blowers; Schedule 7931—two feed-water heaters; Schedule 7929—two electric traveling hoists. Puget Sound, Wash., Schedule 7928—one linseed-oil meter, two duplex boiler-feed pumps, portable hand pumps and two steel storage tanks. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Foreign trade opportunities are announced by the Bureau of Foreign and Domestic Commerce in the Commerce Reports as follows: No. 15,684—An American business firm in New York has informed the Bureau of Foreign and Domestic Commerce that a representative of a group of Russian capitalists who are interested in the exchange of commodities between Russia and the United States wish to communicate with American firms dealing in electric lamps, commercial stationery and aniline dyestuffs. No. 15,688—The manager of the street-cleaning department of a city in Greece has informed an American consular officer that it is desired to purchase motor-driven street-cleaning machinery. It is stated that plans and specifications may be seen at the Greek Legation in Washington and that arrangements may be made to demonstrate American machinery to a representative of the Greek Legation. No. 15,699—An American consular officer in a Mediterranean Sea city reports that a local electric-light company has requested him to secure full particulars, specifications, etc., for a 100-hp electric motor. Possible date of delivery should also be stated. No. 15,714—An American consular officer in Europe reports that a business man in his district desires to represent American manufacturers of centrifugal pumps, particularly the self-contained type, operating by direct electrical current at 220 volts. Correspondence should be in Spanish. No. 15,749—A business man in Central America has informed one of the commercial agents of the Bureau of Foreign and Domestic Commerce that he is negotiating with one of the governments of Latin America for the installation of a wireless station capable of communicating from 1500 to 2000 miles. He wishes to receive offers, catalogs, prices, etc., from American manufacturers of wireless apparatus; also estimates on the installation of equipment. No. 15,750—An American consular officer in Spain reports that a business man in his district wishes to import vacuum cleaners. Catalogs and correspondence should be in Spanish. No. 15,773—An American consular officer in one of the neutral European countries reports that there is needed 5000 tons of copper for local consumption. The Department of State has cabled for names and addresses of interested firms. When received they may be obtained at the Bureau of Foreign and Domestic Commerce. No. 15,776—One of the

commercial agents of the Bureau of Foreign and Domestic Commerce in South America reports that the management of a cotton mill informs him that it is desired to equip the entire mill for electrical operation. It is stated that plans of an oil engine-driven plant should be submitted. Forty motors from 4 hp to 20 hp each will be required. Correspondence may be in English. No. 15,778—The Bureau of Foreign and Domestic Commerce has been informed by an agent in France that he desires to represent American manufacturers of malleable-iron and steel products, gas and electric meters, straight and shaped burners (pendent and stem), and plumbers' tools. No. 15,784—One of the commercial agents of the Bureau of Foreign and Domestic Commerce reports that a large electrical supply house in South America wishes to get into communication with American manufacturers and exporters of kerosene, heavy oils, cement, electrical apparatus, small lighting sets, cotton-mill machinery, telephones, water meters, etc. The firm is now representing American manufacturers of farming implements. No. 15,793—The Bureau of Foreign and Domestic Commerce is advised by one of its commercial agents that a railway and power company in Latin America desires to get into communication with American firms which may be in a position to supply electric-railway signal apparatus. Catalogs, prices, etc., should be sent at once. Correspondence should be in English. Further information may be obtained upon application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its branches.

North Central

ALPENA, MICH.—Plans are being prepared by City Enginer McNeil for the proposed extension to the ornamental street-lighting system, to cost about $10,000.

DETROIT, MICH.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 30 for the installation of an electric freight elevator, etc., in the extension of the United States post office and court house in Detroit. For details see proposal columns.

GRAND RAPIDS, MICH.—Bids, it is reported, will be received by B. I. Pratt, secretary of light and power commission, Grand Rapids, until March 10 for pumping equipment for municipal electric plant, consisting of two 40-hp, 2200-volt, three-phase motors for driving two pumps of 750-gal. capacity per minute.

OVID, MICH.—The managers of the municipal electric-lighting plant are contemplating the purchase of an electrically driven pump for the water-works department; also within the next six months to purchase electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. B. A. Wilkinson is superintendent.

PETOSKEY, MICH.—Preliminary steps are being taken by the Department of Electricity of Petoskey, it is reported, to develop a large hydroelectric project, 16 miles above Petoskey, where it is estimated that from 1500 hp to 2000 hp can be developed. Work, it is understood, will begin as soon as the weather will permit.

TRAVERSE CITY, MICH.—The electric light commissioners are considering the installation of a 400-kw turbo-generator as an auxiliary to the present hydroelectric installation this year. William Gifford is superintendent.

ADA, OHIO.—The Ada Ht. & Lt. Co. expects to purchase within the next six months a boiler for its plant. Charles Wood is general manager.

BUCYRUS, OHIO.—The Bucyrus Lt. & Pwr. Co. has placed orders for one 600-kw General Electric turbine unit complete, with switchboard panels, one 25-kw exciter set, new water-tube boilers, condensers and auxiliaries. A. G. Moser is superintendent.

CADIZ, OHIO.—The electric plant of the Cadiz El. Lt. & Pwr. Co. was recently destroyed by fire, causing a loss of about $10,000.

CHICAGO JUNCTION, OHIO.—Within the next six months the Board of Trustees of Public Affairs expects to purchase additional pumping machinery for the municipal electric-light and water-works plant. E. K. McMorris is clerk of board.

CINCINNATI, OHIO.—The contract for electrical work in the ten-story office building to be erected at Sixth and Sycamore Streets has been awarded to the Beattie Electrical Co., of Cincinnati.

CLEVELAND, OHIO.—Downtown substations for furnishing direct-current service are to be erected by the municipal lighting division with a portion of the $700,000 voted by the City Council for extensions to the municipal electric-light plant.

CLEVELAND, OHIO.—Plans, it is reported, are being prepared by the Cleveland Ry. Co., Leader Building, Cleveland, for the construction of a two-story power house (60 ft. by 120 ft.), to be situated at Harvard Avenue and East Forty-ninth Street, Cleveland.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, 511 City Hall, Cleveland, until March 12, for rubber-covered, lead-incased copper wire for the municipal electric-light department, in accordance with specifications which may be obtained at the office of the commissioner of light and heat division, 1443 East Third Street.

MIDDLETOWN, OHIO.—Plans for the proposed new street-lighting system, including ornamental lamps for the business district, providing for a ten-year contract, have been approved by the City Commission. The clerk of the commission has been instructed to advertise for bids for same.

SALINEVILLE, OHIO.—Within the next six months the Salineville El. Lt., Ht. & Pwr. Co. expects to purchase one 75-kw Westinghouse single-phase, 60-cycle, 1100-volt belted generator (second hand). P. S. Hart is general manager.

SOUTH SOLON, OHIO.—The City Council has granted the Washington Gas & El. Co., of Washington C. H., a franchise to supply electricity in South Solon. Work will begin on the system as soon as the company secures the right-of-way for extension of its transmission line.

EMMA, KY.—The Floyd Mining Co., recently incorporated, contemplates developing 1000 acres of mining lands, and proposes, it is reported, to install an electric generator.

HICKMAN, KY.—The Pub. Ser. Co. of Western Kentucky, of Hickman, will install a centrifugal pump, having a capacity of 400 gal. per minute, in its plant within the next few weeks. W. C. Morehead is vice-president.

NEWPORT, KY.—Chris. Ebert, commissioner of public safety, is advocating a plan for the construction of a joint light and water plant for the use of the cities of Covington and Newport.

COVINGTON, IND.—Bids will be received by Charles A. Baldwin, city clerk, Covington, until March 15 for the installation of an engine-driven generating unit, exciter and switchboard and street-lighting equipment. The cost of the work is estimated at $5,500.

MITCHELL, IND.—The City Council is reported to be considering rebuilding the municipal electric-light plant. H. A. Miller is superintendent.

CHICAGO, ILL.—The Farrar Pump & Machinery Co., Granite Building, St. Louis, Mo., submitted the lowest bid for the erection of the South Quincy Drainage and Levee District pumping plant, including the construction of power house and furnishing two 36-in. centrifugal pumps, electrically driven. The amount of the bid was $23,040.

CHICAGO, ILL.—Bids will be received by John McGillen, clerk of the Sanitary District of Chicago, 700-910 South Michigan Avenue, Chicago, Ill., until March 18 for pole erection and line construction in the streets of the city of Chicago, according to plans and specifications which may be obtained at the office of the Sanitary District. For details see proposal columns.

NOKOMIS, ILL.—Judge Thomas Jett of the Circuit Court has granted the Central Illinois Pub. Ser. Co. a permanent injunction restraining the city of Nokomis from establishing a municipal electric-lighting plant in conformity with a vote of the people at a special election.

INDEPENDENCE, WIS.—Bids will be received by the Board of Education of the joint school district No. 6 of Independence and Burnside, Wis., at the city of Independence, until March 11 for heating and ventilating, plumbing and electric wiring of school building in accordance with plans and specifications prepared by Olin H. Round, architect, 302 Oppenheim Building, St. Paul, Minn., where copies may be obtained upon deposit of $15, one-half of which will be retained by the architect for cost of duplicating plans. Plans are on file at the office of Board of Education, Independence, Wis., at the office of the architect, St. Paul, and at the Builders' Exchange in St. Paul, and Minneapolis, Minn., and Milwaukee, Wis.

JANESVILLE, WIS.—Edward Amerphol, chairman, and W. J. McDowell, secretary, of the Commercial Club, have been appointed to take charge of the installation of an ornamental lighting system in the business district. The merchants will pay for the installation and the city will maintain the lamps. The Janesville El. Co. will probably install the system.

MARKESAN, WIS.—The Markesan El. Co., recently incorporated with a capital stock of $15,000, it is reported, contemplates the installation of an electric-light plant.

SHAWANO, WIS.—The city of Shawano expects to build a water-power plant of from 400 hp to 500 hp next summer or install a 200-hp engine (directly connected) in the municipal electric plant. Paul E. Capraro is superintendent.

ADA, MINN.—Within the next three months the Board of Public Works expects to purchase coal-handling apparatus and one boiler-feed pump for the municipal electric-lighting plant. O. Sandvold is superintendent.

HIBBING, MINN.—The Water and Light Commission is contemplating the purchase of an oil engine for the municipal electric-light plant.

KARLSTAD, MINN.—The installation of an electric-lighting plant in Karlstad is reported to be under consideration.

MONTEVIDEO, MINN.—The property of the Montevideo El. Lt. & Pwr. Co. is reported to have been sold to the Campbell Co., of Huron, S. D., for $180,000.

BRAYTON, IA.—An electric-light franchise has been granted to George Hoegh, who will install a plant in Brayton.

BUFFALO, IA.—Bonds to the amount of $10,000 have been voted for the installation of an electric-lighting system.

COUNCIL BLUFFS, IA.—The City Council is considering the installation of an electric-lighting system to be owned and operated by the municipality.

DEEPWATER, MO.—Bids will be received by G. G. Kennedy, city clerk, Deepwater, until March 16 for furnishing material and construction of electric-light plant. The work will include construction of power house, a 50-hp oil engine, one 37½-kw, three-phase, 60-cycle, 2300-volt generator, exciter and belts, one switchboard and sub-panel, poles, cross-arms, wire, 38 center street lamps, etc. Plans and specifications may be obtained upon application to J. P. Davis, consulting engineer, Windsor, Mo., upon payment of $4, to cover cost of prints. A set of specifications and proposal form for oil engine may be obtained from the engineer for $1.

MIRABILE, MO.—A. F. Houghton, of Mirabile, it is reported, is contemplating the installation of an electric-lighting plant.

ST. LOUIS, MO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 30 for the installation of a hydraulic freight lift in the United States post office in St. Louis, Mo. For details see proposal columns.

MINTO, N. D.—Plans are being considered to install an electric-lighting system in Minto. It is proposed to secure electricity from the municipal electric-light plant in Grafton to operate the system.

PARK RIVER, N. D.—Within the next 12 months the managers of the municipal electric-lighting plant and water-works system expect to purchase a 75-kw, three-phase, 2300-volt generator. A. E. Mullineaux is superintendent.

HARTFORD, S. D.—The Hartford El. Lt. & Tel. Co., it is reported, is contemplating extending its transmission lines to Montrose to supply electrical service there.

SUMMIT, S. D.—The proposal to issue $5,000 in bonds for the installation of a municipal electric-lighting plant will be submitted to the voters on March 23.

CHADRON, NEB.—The Chadron Ice & Creamery Co. is reported to be contemplating the installation of an electric-lighting plant and ice factory, to cost about $60,000. C. P. Coffee is president.

LYONS, NEB.—Bids will be received by M. L. Shumway, village clerk, until March 16 for the construction of a power plant, pole line and lighting system. Albert C. Arend, Brandeis Building, Omaha, is consulting engineer.

MINDEN, NEB.—During the coming summer the city of Minden expects to install two 30-hp motors to drive the water pumps and also to extend the service lines of the municipal electric-lighting system to cover the entire city, which will require about 5 miles of new pole line. The water and light commission is also contemplating the installation of a steam-heating plant to supply steam heat to the business district and the court house; exhaust steam from the power plant will be utilized. The present plans also provide for the construction of a new coal house with a capacity of 200 tons. V. V. Sears is light and water commissioner.

ST. PAUL, NEB.—At an election held recently the proposal to issue bonds for the

installation of a municipal electric-light plant was defeated.

YORK, NEB.—Bids will be received by the board of directors of the Evangelical Lutheran Hospital Association, York, Neb., until March 18, for construction of a two-story and basement hospital building, including wiring, plumbing and heating, in accordance with plans and specifications prepared by W. F. Gernandt, architect, State Bank Building, Omaha.

ELLSWORTH, KAN.—The local electric-light plant, owned by Mrs. Paul Reaume, it is reported, will be remodeled and new equipment installed. The cost is estimated at about $9,000. The contract has been awarded to John Snowball, of Ellsworth.

McCUNE, KAN.—Henrici, Kent & Lowry Engineering Co., 715 Reserve Bank Building, Kansas City, Mo., has been engaged as consulting engineer in connection with the construction of water-works system. A well has already been sunk to the depth of approximately 1200 ft. The date for letting the remainder of the contracts has not been set, depending on the testing of the well.

PORTIS, KAN.—The citizens have voted to erect a transmission line from the power plant of John Abrahams in Downs to Portis, to supply electrical service here. The cost of the line is estimated at $4,000.

Southern States

LEAKSVILLE, N. C.—Within the next two months the Leaksville Lt. & Pwr. Co. expects to purchase one 60-kw to 100-kw, three-phase, 60-cycle generator (second hand) and exciter for same; also a street-lighting outfit, regulator, transformer, etc. (new or second hand).

NEWBERN, N. C.—The Newbern St. Ry. Co., which has been operating storage-battery cars for several years, is preparing to change over to the trolley system. Orders for material, it is understood, have been placed. C. J. McCarthy is manager.

OXFORD, N. C.—The Carolina Pwr. & Lt. Co., of Oxford, has recently completed a 60,000-volt pole transmission line from Oxford to Roxsboro to supply electricity to the town and the cotton mills there. H. S. Lee is superintendent of central station.

WILSON, N. C.—A new 1500-hp power plant is being completed for the municipal electric-light system. The equipment consists of cross-compound condensing Hamilton engines and Western Electric generators, two units of 750 hp. each. R. J. Grantham is city engineer.

HONEA PATH, S. C.—The Council is contemplating the installation of an ice plant in connection with the municipal electric-lighting and water-works system this spring. J. A. Featherstone is superintendent.

UNION, S. C.—The Commissioners of Public Works have decided to extend the water mains to another creek for additional water supply and to erect a 6600-volt, three-phase transmission line to supply energy to operate pumps, for which $25,000 has been appropriated. R. A. Esterling, superintendent, has charge of the work.

WINNSBORO, S. C.—The Board of Public Works has awarded the contract for the installation for a 125-kva generating unit in the municipal electric-lighting plant to the J. B. McCrary Co., of Atlanta, Ga. T. R. Ellison is superintendent.

LIVE OAK, FLA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 6 for the construction, including mechanical equipment, interior lighting and approaches, of the United States post office at Live Oak, Fla. Drawings and specifications may be obtained from the above office or from the custodian of site at Live Oak. O. Wenderoth is supervising architect.

JACKSON, TENN.—The City Council has passed an ordinance requiring that all wires (except the trolley wires) in the fire district be placed underground. This measure affects the city, the Jackson St. Ry. & Lt. Co., the Western Union Teleg. Co. and the two telephone companies.

PULASKI, TENN.—New equipment is being installed in the municipal electric-light plant, including two high-pressure boilers of 125 hp each with separate stacks, one heater, one pump, one 125-hp Chuse automatic side-crank engine and a 150-kva, three-phase, 60-cycle, 2300-volt generator with exciter. E. T. Cheatham is superintendent.

WAVERLY, TENN.—The City Lt. & Wtr. Co., recently incorporated with a capital stock of $4,000, proposes to install and operate an electric-lighting plant and water-works system. H. W. Hooper, J. D. Luten and others are among the incorporators.

GUNTERSVILLE, ALA.—Plans are being considered for the installation of an electric-lighting plant in Guntersville. The Town Council, it is reported, would like to receive propositions from parties who would install the system. D. Isbell is Mayor.

LINCOLN, ALA.—The Alabama Pwr. Co., of Birmingham, has been granted a franchise to supply electrical service in Lincoln. The transmission lines of the company already pass through the town, and it expects to distribute electricity here some time within the next few months.

HATTIESBURG, MISS.—The question of establishing a municipal electric-lighting plant is under consideration by the City Commissioners. It is estimated that a plant with sufficient output to supply the needs of the city would cost from $30,000 to $35,000.

CORNING, ARK.—G. A. Booser has been granted a franchise to supply electricity in Corning.

FORT SMITH, ARK.—Plans are being considered by the Board of Municipal Commissioners for the installation of an electric-lighting plant, to cost about $200,000. M. H. Reed is city engineer.

BARTLESVILLE, OKLA.—Plans are being considered by the Bartlesville Interurban Ry. Co. to enlarge its power plant, at a cost of about $5,000. An addition will be erected to the present building and a condenser installed.

BEAUMONT, TEX.—The installation of new street lamps and improvements to electric plant is reported to be under consideration by the Beaumont El. Lt. & Pwr. Co.

BROWNSVILLE, TEX.—Present plans for the proposed ornamental lighting system in the business district provide for 65 standards. The number of lamps has not yet been decided upon. F. H. Williams is superintendent.

DALLAS, TEX.—The directors of the Texas Pwr. & Lt. Co., of Dallas, have authorized an additional issue of bonds to the amount of $250,000, the proceeds to be used to complete extensive improvements under way by the company, including the construction of power plants in Paris and Waco. J. F. Strickland is president.

HOUSTON, TEX.—Plans are being considered by the City Council for the installation of a municipal electric-lighting plant in the city water-works station to supply electricity to operate part of the machinery at the water plant and to light several new bridges, the city auditorium, the city hall and the police station. When the plant is completed ornamental lamps will be erected in the City Hall Square and possibly on Market Square. The cost of the plant is estimated at $20,000. This plant will be entirely separate from the larger plant that the city expects to erect on the water front, near the turning basin, to supply energy to operate the wharf machinery on the municipal piers.

LA PORTE, TEX.—The La Porte Wtr., Lt. & Ice Co. is contemplating extending its services to residents along the shore of Galveston Bay and Morgan's Point, a distance of about 2 miles; also installing a 15-ton ice plant. Phil J. Pfeiffer is president and manager.

SHERMAN, TEX.—Contracts, it is reported, have been placed by the City Council for equipment for extensions to the street-lighting system. H. L. McDuffie is superintendent.

THORNTON, TEX.—The City Council is reported to have granted a franchise for the installation of an electric-lighting plant in Thornton.

Pacific States

SPOKANE, WASH.—Harry A. Flood, president of the Trustee Co., which some time ago was granted a franchise to construct and operate an electric light, power and steam-heating system in Spokane, has announced that work will begin on construction of the plant this spring. The cost of the proposed system is estimated at $300,000.

VANCOUVER, WASH.—Preparations are being made by the Portland Ry., Lt. & Pwr. Co. to make changes in the street-lighting system in Vancouver, to conform with plans laid out by the lighting committee of the Council. It is proposed to replace arc lamps in various parts of the city with tungsten lamps.

WASHTUCNA, WASH.—During the summer the Washtucna El. Lt. & Pwr. Co will build a concrete penstock and install a new water turbine. Robert E. Mulligan is manager.

GRANT'S PASS, ORE.—The Rogue River Pub. Ser. Corpn. has applied to the City Council for a franchise to supply electricity in Grant's Pass for a period of 30 years. The application also makes a provision that when the consumption has reached 220,000 kw-hr. per month the city may take over the distribution system on an appraised valuation and contract with the company for energy to operate the same. The general offices of the company are in Grant's Pass. George W. Soranson is secretary.

SHERWOOD, ORE.—The Tualatin Valley El. Co., of Sherwood, is planning to extend its electric transmission lines to Tualatin, Tigard, Greensboro and the Metzger districts. A street-lighting system will be installed in Tualatin at once.

GRANGEVILLE, IDAHO.—The Idaho Legislature is aiding a project to build an electric railway connecting northern and southern Idaho. It is proposed to authorize a $100,000 bond issue to supplement a smaller amount raised by counties and then use convict labor to build a north and south State highway. The proposed railway will extend from Grangeville to Whitebird, Riggs and New Meadows.

LEWISTON, IDAHO.—The Lewiston-Clarkston Transit Co., of Lewiston, expects to purchase a 125-hp motor-generator set for its power house here.

LEWISTON, IDAHO.—The Lewiston-Clarkston Transit Co. has recently applied for a charter in Idaho for the purpose of constructing and operating electric railways in the Lewiston-Clarkston Valley. The company, it is understood, will begin work early in March on the erection of a transmission line from Lewiston to Orchard Tracts, to Asotin, and through Clarkston and to the fair and stock grounds east of Lewiston. R. C. Dahlhjelm and Eugene A. Cox, of Lewiston, are among the incorporators. The capital stock is placed at $500,000.

POCATELLO, IDAHO.—Plans are being prepared for the installation of a cluster-lamp street-lighting system on portions of Center and Main Streets. William H. Jackson, Jr., is city clerk.

FOUNTAIN GREEN, UTAH.—The Big Springs El. Co., of Fountain Green, expects to extend its service to the small town of Wales. The connection is to be made from Moroni. Ernest R. Anderson is manager.

OGDEN, UTAH.—Bids will be received at the office of the purchasing agent, Forest Service, Ogden, Utah, until April 6 for furnishing steel and copper telephone wire, brackets, insulators, barbed and barbless fencing wire and woven-wire fencing to the Forest Service during the fiscal year beginning July 1, 1915. Proposal blanks and specifications may be obtained upon application to the above office.

MESA, ARIZ.—The installation of an irrigation system is reported to be under consideration by the Queen Creek Pwr. & Wtr. Co.

BOX ELDER, MONT.—A committee, consisting of Levi Fossum, Dr. J. W. McKenzie and E. C. Sprague, has been appointed by the Town Council to confer with nearby electric companies regarding the extension of transmission lines to this city.

CHINOOK, MONT.—The Montana Pwr. Co., of Great Falls, it is reported, is contemplating purchasing the property of the Chinook Lt. & Pwr. Co. and extending its transmission lines to Chinook. If the deal is consummated, the local plant will be closed down and the system connected with the Havre branch of the Montana company.

FORT BENTON, MONT.—The Montana Pwr. Co., of Great Falls, it is reported, has purchased the controlling interest in the Benton El. Lt. Co., of Fort Benton. The new owners, it is reported, will rebuild the entire system and install new equipment.

LOVELAND, COL.—An election will be held April 6 to submit to the voters the proposal to issue bonds for the installation of a municipal electric-light plant in Loveland. The cost of the plant is estimated at about $79,000.

OLATHE, COL.—The Western Colorado Pwr. Co., of Durango, has been granted a franchise to supply electricity for lamps and motors in Olathe.

STERLING, COL.—The Sterling Consol. El. Co. expects to install a 200-kva or 250-kva, three-phase, 60-cycle, 2300-volt generator directly connected to prime mover this spring. H. L. Titus is secretary and manager.

Canada

AYLMAR, ONT.—The city of Aylmar is contemplating installing hydroelectric power. D. C. Davis is secretary and manager of the water-works and electric-light department.

NEWMARKET, ONT.—The ratepayers on Feb. 22 voted in favor of the by-laws authorizing the Council to contract with the Toronto & York Radial Ry. Co. for a minimum supply of electricity to the amount of 500 hp for a period of five years and to appropriate $15,000 to finance the extensions.

SMITH FALLS, ONT.—The Smith Falls El. Pwr. Co. is contemplating the installation of a 750-kw vertical generating unit. George B. Frost is manager.

THAMESVILLE, ONT.—Plans are being considered to secure energy from the Hydro-Electric Power Commission of Ontario in Thamesville. The commission has quoted a rate of $48 per hp per year. The Town Council has authorized estimates to be prepared of the cost of the construction of a new hydroelectric system to supply electricity for lamps and motors in Thamesville.

TORONTO, ONT.—Tenders will be received by the Toronto electric commissioners, Toronto, until March 11 for transformers. Specifications may be obtained at the office of the purchasing agent of the Toronto electric commissioners.

MONTREAL, QUE.—Plans will soon be submitted to the City Council by the superintendent of lighting for street-lighting on St. Catherine and Bleury Streets, providing for the erection of 200 ornamental single-lamp standards.

Directory of Electrical Associations

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, H. O. Hanson, Mobile Gas Co., Mobile, Ala.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Permanent secretary, L. O. Howard, Smithsonian Institution, Washington, D. C. Meeting, San Francisco, Aug. 2-7.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary, Eugene W. Stern, 101 Park Ave., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York. Board of directors meets monthly. Selections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. Secretary, William H. Ross, 154 Nassau St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Secretary, Edwin A. Scott, 29 West 39th St., New York.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Little Rock, May 11-13.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Assistant secretary, Walter Neumuller, Irving Place and 15th St., New York.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, W. T. Snyder, McKeesport, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Jos. A. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 112 West Adams St., Chicago.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, W. S. Hanbridge, 1408 Merchants' National Bank Building, Los Angeles, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Secretary-treasurer, Alan Sullivan, 10 Adelaide Street East, Toronto, Can.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION, N. E. L. A. Secretary, J. F. Becker, 130 East 15th St., New York.

EASTERN NEW YORK SECTION, N. E. L. A. Secretary, C. S. Van Dyck, Schenectady.

ELECTRICAL CONTRACTORS' ASSOCIATION OF MASSACHUSETTS. Secretary, H. D. Temple, 30 Foster St., Worcester, Mass.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russel, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, A. J. Burns, 318 West Tenth St., Kansas City, Mo.

ELECTRICAL CONTRACTORS' ASSOCIATION OF THE STATE OF PENNSYLVANIA. Secretary, M. G. Sellers, 1518 Sansom St., Philadelphia.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, Albert Petermann, 626 Lloyd St., Milwaukee, Wis.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill. Meeting, Chicago, March 17-19.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Executive secretary, A. Jackson Marshall, 29 West 39th St., New York. Sections in New York, New England, Chicago, Philadelphia Washington and Los Angeles.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, Prof. H. V. Bozell, Norman, Okla.

GEORGIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. M. Clayton, Atlanta.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, C. A. Littlefield, 29 West 39th St., New York. Annual convention, Washington, D. C., September.

INDEPENDENT TELEPHONE ASSOCIATION OF AMERICA. Secretary, W. S. Vivian, 19 South LaSalle St., Chicago.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INDIANA STATE ELECTRICAL CONTRACTORS' ASSOCIATOIN. Secretary, George Skilman, Indianapolis, Ind.

INSTITUTE OF OPERATING ENGINEERS. Secretary, L. Houmiller, 29 West 39th St., New York

INSTITUTE OF RADIO ENGINEERS. Secretary, David Sarnoff, 71 Broadway, New York.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION. President, Charles Kratsch, 416 West Indiana St., Chicago. Meeting second Friday of each month at Lewis Institute.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ENGINEERING CONGRESS. Secretary-treasurer, W. A. Cattell, Foxcroft Building, San Francisco, Cal. Congress, San Francisco, September.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (International body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Meeting at San Francisco, Sept. 9-11.

IOWA SECTION, N. E. L. A. Secretary, W. H. Thomson, Des Moines, Ia. Annual meeting, Keokuk, Ia., April 20-22.

IOWA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, M. T. Humphrey, Waterloo, Ia.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

JOVIAN ORDER. Jupiter (president), Homer E. Niesz, Chicago, Ill.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary-treasurer, Ivor Thomas, 237 South Main St., Wichita, Kan.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. J. Ziegler, 227 Bourbon St. Meeting every Wednesday, Audubon Building, New Orleans.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Waterville, Maine.

MICHIGAN ELECTRIC ASSOCIATION. Affiliated with N. E. L. A. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich. Annual meeting June.

MINNESOTA ELECTRIC ASSOCIATION. Secretary-treasurer, F. A. Otto, St. Paul Gas Light Company, St. Paul, Minn. Annual meeting, St. Paul, March 23-25.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the National Electric Light Association. Secretary-treasurer, H. F. Wheeler, Hattiesburg, Miss. Annual meeting, Hattiesburg, April 12-14.

MISSOURI PUBLIC UTILITIES ASSOCIATION. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis. Convention, May 27.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, Wm. L. Smith, Concord, Mass. Annual convention, New York, March 23, 1915.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Chicago, June 1-3.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual meeting, San Francisco, June 7-11.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, George H. Duffield, 41 Martin Building, Utica, N. Y. Annual meeting, San Francisco, July 18-24.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass. Meeting electrical committee, New York, March 24 and 25.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Permanent headquarters, Room 204, Hotel LaSalle, Chicago, Ill.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, S. J. Bell, David City, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 60 State St., Boston, Mass.

NEW ENGLAND SECTION, ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, L. L. Edgar, 39 Boylston St., Boston, Mass.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. E. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, E. A. Thiele, Roswell, N. M.

NEW YORK ELECTRIC RAILWAY ASSOCIATION. Secretary, Charles C. Dietz, 365 East 21st St., Brooklyn, N. Y.

NORTHWEST SECTION, N. E. L. A. Secretary, N. W. Brockett, Pioneer Building, Seattle, Wash.

NORTHERN WHITE CEDAR ASSOCIATION. Secretary, R. N. Boucher, 743 Lumber Exchange, Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, July 20-23.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary-treasurer, J. W. Oberender, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION (State Section N. E. L. A.). Secretary-treasurer, H. N. Müller, Pittsburgh, Pa.

RAILWAY SIGNAL ASSOCIATION. Secretary-treasurer, C. E. Rosenberg, Times Building, Bethlehem, Pa.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York. Annual meeting, New York, May 11, 1915.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual meeting, Ames, Ia., June 22-25.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, Geo. H. Wygant, Tampa, Fla.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, C. H. West, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, 1410 First National Bank Building, Milwaukee, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 23, 1915.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,129,062. MINE SECTION-INSULATOR SWITCH: G. H. Bolus, Mansfield, Ohio. App. filed Feb. 20, 1914. Rotatable switch blade.

1,129,083. REGULATING APPARATUS FOR FURNACES; R. L. Frink, Cleveland, Ohio. App. filed July 16, 1908. Particularly for glass furnaces.

1,129,087. TELEPHONE RECEIVER; E. Grisinger, Buffalo, N. Y. App. filed Nov. 18, 1911. Double watchcase receiver with the permanent magnets back to back.

1,129,097. ELECTRIC-RAILWAY SWITCH; G. Hyler and B. Herbison, Lansing, Mich. App. filed May 29, 1913. Controlled from the moving car.

1,129,114. AUTOMATIC RECORDING MECHANISM; H. Y. Norwood and F. W. Stalker, Rochester, N. Y. App. filed Nov. 24, 1913. For temperature recorders particularly.

1,129,117. ARC LAMP; W. L. Patterson, Rochester, N. Y. App. filed June 8, 1912. Manual adjustment means for the electrodes.

1,129,126. HOT-WIRE ELECTRIC MEASURING INSTRUMENT; O. Schumann, Frankfort-on-the-Main, Germany. App. filed May 6, 1911. For high-frequency currents.

1,129,143. SYSTEM OF AUTOMATIC BLOCK SIGNALING FOR ELECTRIC RAILWAYS; F. Townsend, New York, N. Y. App. filed June 16, 1904. Includes alternating-current multiphase generator for track circuits.

1,129,147. POWER SYSTEM FOR AUTOVEHICLES; R. Varley, Englewood, N. J. App. filed Nov. 6, 1912. Torque-multiplying mechanism for starting the engine.

1,129,181. PRESS PLATES: G. W. Ehrhardt and M. Schiavon, Chicago, Ill. App. filed June 24, 1913. Electrically heated; for embossing presses.

1,129,182. HEATED PRESS PLATE FOR EMBOSSING; G. W. Ehrhardt and M. Schiavon, Chicago, Ill. App. filed Jan. 15, 1914. Electrically heated and adapted to be used on an ordinary printing press.

1,129,216. IGNITION GENERATOR FOR ELECTRIC STARTER SYSTEMS; A. L. McMurtry, Sound Beach, Conn. App. filed March 13, 1913. An auxiliary generator armature on motor-generator supplies ignition current at starting.

1,129,231. TRANSFORMER; L. T. Robinson and J. R. Craighead, Schenectady, N. Y. App. filed Jan. 3, 1913. For power measurement.

1,129,234. IGNITER FOR INTERNAL-COMBUSTION ENGINES; M. P. Ryder, Springfield, Mass. App. filed Oct. 20, 1909. Axial adjustment of rotary twin cam serves to advance or retard spark.

1,129,236. WARMER FOR STEERING WHEELS; C. T. Schroyer, Sioux Falls, S. D. App. filed May 23, 1914. Sectional heater casing fitting on steering wheel.

1,129,241. ELECTROPLATING APPARATUS; C. N. Smith, Elgin, Ill. App. filed July 20, 1914. Special facilities for inserting or removing anode and cathode plates.

1,129,277. CONNECTION PROTECTOR AND TROLLEY REPLACER; A. J. Conlon, P. J. Murphy and J. T. Tighe, Scranton, Pa. App. filed April 9, 1912. Curved guard plate attached to "frog" or "cross-over."

1,129,285. ADJUSTING DEVICE FOR ARC LAMPS; L. Fort, Jersey City, N. J. App. filed Feb. 16, 1912. Clamp for holding the flexible suspending cable.

1,129,287. ELECTROMAGNETIC SWITCH; S. E. Gamble, Petaluma, Cal. App. filed Oct. 23, 1913. For high-voltage circuits.

1,129,292. ELECTRIC SIGNALING MECHANISM FOR ELEVATORS; H. A. Humphrey, Kansas City, Mo. App. filed May 31, 1910. A single brush controls the circuits connected with the commutator.

1,129,305. CAR SIGNAL; J. F. McElroy, Albany, N. Y. App. filed Feb. 27, 1912. Starting signal circuit is momentarily closed when the last one of a series of doors is closed.

1,129,317. TELAUTOGRAPHIC APPARATUS; G. S. Tiffany, Summit, N. J. App. filed Feb. 24, 1912. Particularly for train-dispatching purposes. (Fifty-three claims.)

1,129,330. CONVERTER; C. L. Cadle, Rochester, N. Y. App. filed Dec. 18, 1911. Divides the current to prevent injurious arcs at commutator segments.

1,129,356. LIGHTNING CONDUCTOR; M. G. Mitchell, South Bend, Ind. App. filed Sept. 9, 1911. Distributer point and clip construction.

1,129,357. LIGHTNING CONDUCTOR FOR TELEPHONE LINES; M. G. Mitchell, South Bend, Ind. App. filed Sept. 16, 1909. For diverting lightning from telephone line to the lightning conductor of a building.

1,129,377. METHOD AND APPARATUS FOR PROTECTING THE ELECTRODES IN ARC FURNACES; J. I. Bronn and W. Schemmann, Rombach, Germany. App. filed Dec. 16, 1913. Impinges steam against the electrodes at the points where they enter the furnace.

1,129,381. ELECTRICAL HEATER; F. E. Carlson, New Britain, Conn. App. filed March 25, 1914. For hot pads, etc.

1,129,395. RENEWABLE CARTRIDGE FUSE; H. M. Huxley, Evanston, Ill. App. filed March 20, 1914. Special clamp for ends of fusible link.

1,129,424. WAVE MODIFIER FOR X-RAY SYSTEMS; C. M. Peabody, South Orange, N. J. App. filed Oct. 2, 1913. Modifying of wave portions by selective variation.

1,129,425. MEANS FOR AUTOMATICALLY STOPPING RAILROAD MOTORS; W. F. Pettes and A. E. Spicer, New York, N. Y. App. filed March 28, 1913. Controlled by track signals.

1,129,438. ILLUMINATING DEVICE; H. Alexander, New York, N. Y. App. filed Jan. 2, 1913. Indirect; special reference to cooling and avoidance of shadows.

1,129,445. CONTACT MAKER AND INTERRUPTER FOR IGNITION SYSTEMS; W. C. Brinton, Jr., Manoa, Pa. App. filed June 4, 1914. Structural features.

1,129,446. CONTACT MAKER AND INTERRUPTER; W. C. Brinton, Jr. Manoa, Pa. App. filed June 16, 1914. Special contact-making devices.

1,129,447. INCLOSED FUSE; W. J. Britt, Jr., St. Louis, Mo. App. filed Dec. 15, 1913. Cartridge type; securing fuse strips to terminals.

1,129,459. RENEWABLE CARTRIDGE FUSE; A. L. Eustice, Chicago, Ill. App. filed March 20, 1914. End clamps for the fuse link.

1,129,460. TERMINAL BUSHING; S. W. Farnsworth, Edgewood Park, Pa. App. filed Nov. 24, 1911. Insulating envelope completely covers exposed surfaces of the structure between the conducting members which it separates.

1,129,463. TRANSFORMER; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. Core type; voltage stress properly distributed through insulation.

1,129,464. TRANSFORMER AND WINDING; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. Same length of mean turn for all coils and coils separated from core according to their potential.

1,129,465. TRANSFORMER; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 7, 1911. Outdoor series transformer.

1,129,466. TRANSFORMER TERMINAL; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 7, 1911. Has a specially cooled conducting lead.

1,129,467. TERMINAL FOR ELECTRICAL APPARATUS; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 7, 1911. Testing transformer for plurality of circuit connections.

1,129,468. TERMINAL BUSHING; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 24, 1911. Condenser-type insulation, protected against rapid deterioration.

1,129,469. TRANSFORMER; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. Plurality of spaced coils with insulating structure.

1,129,470. ALTERNATING-CURRENT TRANSFORMER; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. High-tension: occupying materially reduced space and of low manufacturing cost.

1,129,471. TRANSFORMER WINDING; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. Requires very small amount of insulation.

1,129,472. ELECTRIC-CURRENT TRANSFORMER; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. Square core and four groups of concentric coils disposed on the respective legs of the core.

1,129,473. TRANSFORMER FOR ELECTRIC CURRENTS; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. Condenser-type insulation.

1,129,474. TRANSFORMER; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 2, 1909. Eliminates disturbances in insulating structure resulting from the existence of capacities.

1,129,486. INSULATING STRUCTURE; F. W. Harris, Wilkinsburg, Pa. App. filed Jan. 7, 1911. Bushing for high-voltage transformers.

1,129,499. HIGH-VOLTAGE TRANSFORMER; J. E. Mateer, Wilkinsburg, Pa. App. filed Jan. 10, 1912. Series type; high-potential insulator supports the high-potential winding.

1,129,500. TERMINAL BUSHING; J. E. Mateer, Wilkinsburg, Pa. App. filed March 2, 1912. Condenser type; for outdoor high-potential transformers, etc.

1,129,512. ELECTRIC FURNACE; S. Peacock, Chicago, Ill. App. filed Sept. 20, 1913. Resistance type; for fixing atmospheric nitrogen.

1,129,520. INSULATING BODY FOR ELECTRICAL APPARATUS; K. C. Randall, Edgewood Park, and S. W. Farnsworth and C. Le G. Fortescue, Pittsburgh, Pa. App. filed April 30, 1910. High-voltage; utilizing value of air.

1,129,521. ELECTRICAL INSULATOR; K. C. Randall, Edgewood Park, and S. W. Farnsworth and C. Le G. Fortescue, Pittsburgh, Pa. App. filed April 30, 1910. Conforms to the direction of static lines of force extending between the conducting parts.

1,129,541. ELECTRIC RELAY SYSTEM; J. Bergman, Brooklyn, N. Y. App. filed May 3, 1913. Messenger call.

1,129,543. AUTOMATIC OR SEMI-AUTOMATIC TELEPHONE-EXCHANGE SYSTEM; G. A. Betulander, Södertörns Villastad, Sweden. App. filed Feb. 27, 1914. Selecting and connecting operations effected separately and by separate means.

1,129,565. SOUND-RECEIVING APPARATUS USED IN SUBMARINE SOUND SIGNALING: J. Gardner, Fleetwood, England, App. filed Dec. 27, 1909. Microphone operated by a vibratory ring attached to the diaphragm.

1,129,568. ELECTRICAL SWITCH; B. D. Horton, Detroit, Mich. App. filed July 31, 1912. Armor-clad with accelerated make and break.

1,129,569. ELECTRICAL SWITCH; B. D. Horton, Detroit, Mich. App. filed Nov. 1, 1913. "Iron-clad"; switch cover cannot be swung to a position where it will stay open of itself.

1,129,596. TIME-CONTROLLED DEVICE; S. W. and R. H. Pearce, Tushka, Okla. App. filed April 11, 1914. Adapted for attachment to ordinary clock.

1,129,602. CASE FOR PORTABLE ELECTRIC LAMPS; C. H. Polland, Bridgeport, Conn. App. filed Oct. 1, 1914. Takes ordinary dry cells; switch lever holds cell in place.

1,129,628. INDICATOR FOR ELECTRIC SWITCHES; H. H. Berry, London, England. App. filed Aug. 5, 1913. Indicator lamp for "iron-clad" switches.

1,129,690. ELECTRIC STORAGE BATTERY; K. Knobloch, Baltimore, Md. App. filed May 18, 1914. Grid has straight conducting ribs arranged on lines converging at a point beyond the frame of the grid.

1,129,700. DYNAMO; M. S. Lysinger, Norristown, Pa. App. filed June 19, 1912. Light armature revolving around a stationary core.

1,129,728. CLOCK-STRIKING APPARATUS: C. J. Rasmussen, Seattle, Wash. App. filed April 14, 1914. For sounding the hour at different points.

1,129,757. INDICATOR FOR SNAP SWITCHES: G. B. Thomas, Bridgeport, Conn. App. filed April 28, 1914. Rotary top of switch cover forms the indicator.

1,129,782. CORD SUPPORT; C. H. Bissell, Syracuse, and D. C. Gidley, Albany, N. Y. App. filed Feb. 4, 1911. Insulated clamp construction for lamp cords.

1,129,786. BURGLAR ALARM; W. T. Bradshaw, Oakland, Cal. App. filed Oct. 23, 1913. Compact construction for travelers' use.

1,129,805. SIGNALING SYSTEM; C. T. Lademan, Milwaukee, Wis. App. filed April 30, 1912. Step-by-step police call.

1,129,808. SWITCHING DEVICE; O. M. Leich, Genoa, Ill. App. filed May 16, 1910. Hook switch for telephones.

1,129,812. ELECTRIC SWITCH; D. E. Robinson, Enid, Okla. App. filed Jan. 21, 1914. Sliding switch construction.

1,129,818. NEGATIVE ELECTRODE AND PROCESS OF MAKING THE SAME; W. Tassin, Washington, D. C. App. filed June 6, 1914. Mixture of cuprous and cupric oxides.

1,129,821. WIRELESS TELEGRAPHY; L. Tronchon, Paris, France. App. filed Dec. 6, 1912. Two receptions, one with loose coupling and the other with tight coupling.

1,129,822. MAGNETIC SEPARATOR; G. Ullrich, Magdeburg, Germany. App. filed July 3, 1913. Horizontal rotating-cylinder type having readily adjustable magnetic field.

1,129,830. WATERWHEEL GOVERNOR; J. Pearson, Somerset, Wis. App. filed March 19, 1909. Very light fly-balls in combination with electrical contacts.